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INSTALLATION RESTORATION
OF
FRANKFORD ARSENAL, PENNSYLVANIA

CONCEPT PLAN

SEPTEMBER 1977

DEPARTMENT OF THE ARMY
OFFICE OF THE PROJECT MANAGER
FOR
CHEMICAL DEMILITARIZATION AND INSTALLATION RESTORATION
ABERDEEN PROVING GROUND, MARYLAND 21010

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This report provides an approach to the decontamination of Frankford Arsenal in order to permit its disposition as excess DOD property by the General Services Administration. The approach proposal is based on a records research survey. Potential contaminated areas are identified and costs and schedules are presented for decontamination of the Arsenal.

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PREFACE

By its charter the Project Manager for Chemical Demilitarization and Installation Restoration (PMCDIR) is the DOD executive agent for the complete or partial restoration of such posts as designated excess to DA needs. Frankford Arsenal has been designated by DOD to be closed; therefore, Frankford Arsenal comes under the purview of the charter for decontamination prior to release. In a letter dated 23 June 1977, HQ ARRCOM requested PM CDIR to assume the technical direction of the decontamination of Frankford Arsenal.

The purpose of this document is to provide the DA a conceptual approach for accomplishing the decontamination of Frankford Arsenal and for the obtainment of project approval and allocation of resources.

FRANKFORD ARSENAL INSTALLATION RESTORATION
PROJECT PLAN

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EXECUTIVE SUMMARY

This Concept Plan provides an approach to the decontamination of Frankford Arsenal in order to permit its disposition as excess DOD property by the General Services Administration.

The approach proposed in this plan is based on a recent records research survey which disclosed the nature of contamination existing at Frankford Arsenal. Written records are available and provide a good historical background for years during and subsequent to World War II. However, such records are not available dating back to 1816 when Frankford Arsenal was first commissioned. Accordingly, although the plan is based on current knowledge, results from the assessments phase could result in program changes as the magnitude of the problem becomes better defined. Areas of concern which were uncovered during the records research include explosives/pyrotechnics contaminated buildings and their ancillary support systems, unknown quantities of subsurface and underwater unexploded ordnance, interiors of buildings and related ventilation systems contaminated with radiological material, and organic and inorganic chemical contamination throughout many buildings and their ancillary support systems. Of particular concern is the underground waste discharge system which includes sumps, traps, and drain lines that are known to be contaminated with undefined quantities of explosive/pyrotechnic materials.

Six elements of major effort are defined in this plan. They are; (a) 400 Area; (b) Unexploded Ordnance (UXO): (c) Explosives/Pyrotechnics; (d) Radiological; (e) Industrial Chemicals; and (f) Project Supporting Documentation. Other than the 400 Area and the Project Supporting documentation elements, the other four types of hazards generally are prevalent throughout Frankford Arsenal. The 400 Area, while contamined with Explosives/Pyrotechnics, is singled out as a separate element since an early decision point on decontamination is anticipated and it is a likely candidate area for early release.

Under each of the first five elements is provided available knowledge about (a) the nature and extent of the problems involved; (b) general description of the effort required to further define the hazard; (c) possible approaches to decontamination; and (d) decontamination and verification operations. The Project Supporting Documentation Element describes the several studies and approval documentation judged necessary to carry out this project. This includes preparation of an EIA/EIS.

Applicable regulatory and advisory documentation governing criteria which must be met before clearance statements can be issued are listed in this proposed plan.

Based upon the survey results, the plan provides for a "decontamination decision point" at which time the cost effectiveness of the several alternatives available for land disposition would be weighed against the respective

costs to be incurred in carrying out decontamination operations and recommendations provided. Approval of the recommended decision(s) and the provision of necessary funding by higher authority would serve as the basis for any further decontamination operations.

This plan also provides scheduling and fiscal year funding estimates. A time span of 3 years and a cost of approximately $5,190,000 in FY77 dollars are estimated based on current knowledge. (As the nature and extent of the problem, as well as the methods to resolve the problem are further defined in early phases of the program, revised cost and time estimates will be forwarded as required.) The plan depicts preparation of revised cost and schedule estimates at the completion of Phase I, Technical Data Base Development. Responsibilities between PM CDIR and DA action elements are outlined. Progress reporting procedures and documentation for participating organizations are stipulated as are program review requirements.

1. Introduction.

a. Project Objective: The objective of this plan is to present a centralized management approach for the sufficient decontamination of Frankford Arsenal to meet requirements of the Federal Property and Administration Services Act. Once these requirements have been obtained, the property can be turned over to the General Services Administration for disposition.

b. Concept Plan Overview:

Frankford Arsenal is a 110 acre facility located within the city limits of Philadelphia. It contains a 9 acre area (400 Area) which was dedicated to the production of primer mixes and pyrotechnic materials. The recently completed records search of the Arsenal has indicated that unexploded ordnance (UXO) is likely to be present in certain areas. Many buildings were involved with the loading of propellants, primer materials, and tracer materials; these buildings and ancillary support facilities are contaminated with unknown quantities of explosive and pyrotechnic dusts; some buildings are contaminated with radiological materials and others with toxic substances.

Section 1c deals with the criteria which must be satisfied in order to decontaminate the Arsenal. This section, as well as Section 2 (Background) and Section 3 (Technical Approach), discusses the project in the following sequence: the 400 Area, UXO, Explosive and Pyrotechnical Contamination of Buildings, Radiological Contamination, and Industrial Chemical concerns. Section 4 contains schedule and cost estimates. Section 5 defines PM CDIR and ARRCOM management responsibilities.

c. Criteria for Decontamination:

(1) References:

(a) AR 405-90, "Real Estate: Disposal of Real Estate."

(b) OCE Draft Engineering Pamphlet (EP) 405-1-900, "Real Estate," Chapter 13, Control and Disposition of Contaminated Land.

(c) AR 700-64, Radiological Commodities in the Army.

(d) Nuclear Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors.

(e) Occupational Safety and Health Administration's general industry standards, part 1910, subpara z, section 1910.1000, Title 29 of the Code of Federal Regulations.

(f) American Conference of Governmental Industrial Hygienist's Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment.

(g) Toxic Substances List, U.S. Dept of Health, Education, and Welfare, National Institute for Occupational Health.

(h) Safety Regulations of the 385 series, as applicable.

(2) AR 405-90, "Disposal of Real Estate."

AR 405-90 precludes disposal of real estate contaminated with "explosives, or toxic materials or other innately or potentially harmful elements until such elements have been removed."[1] Appendix E of this regulation, Neutralization (Decontamination) of Proposed Excess Land and Improvements, provides procedures with respect to decontamination. This appendix discusses both areas exposed to contamination by explosives (applicable to the 400 Area and UXO burial areas) and contaminated industrial property (applicable to buildings where contamination from primer materials and propellants has occurred).

In the case of explosives contaminated areas, land is to be freed of such material to the greatest extent practicable and a Statement of Clearance showing the extent to which the area has been cleared of dangerous and explosive materials prepared.[2] Additionally, the following is to be furnished: "Records of neutralization work performed, including statement of methods employed; list of dangerous and explosive materials removed, number and names of demolition technicians employed; and other data that may be pertinent..."[3]

In the case of contaminated industrial property, a description of the contamination present along with a "statement that the area has been cleared of those dangerous and explosive materials reasonably possible to detect either by careful search or by a visual examination" are required.[4]

AR 405-90 also requires that no disposal actions be undertaken until all environmental requirements are satisfied[5] and that disposal proceed in accordance with provisions of the National Historic Preservation Act.[6] These are both necessary considerations for the Frankford Arsenal IR project.

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[1] AR 405-90, 1-6a

[2] Op Cit, E-1c

[3] Op Cit, E-1d

[4] Op Cit, E-1g

[5] Op Cit, 1-20

[6] Op Cit, 1-23

(3) OCE Draft Engineering Pamphlet (EP) 405-1-900, "Real Estate," Chapter 13, Control and Disposition of Contaminated Land:

> The current DOD policy with regard to the release of contaminated land is that real property which is known to be contaminated with hazardous materials which would endanger the general public should not be released until the most stringent efforts have been made to assure appropriate protection to the public.[7]

(4) Radiological Decontamination Criteria

AR 700-64 and NRC Guide 1.86 provide limits for contamination of radiological material in facilities. The amount of contamination which can be removed by wiping the surface (removable) and the amount of contamination fixed in place (fixed) for the radionuclides of interest are specified in these documents. NRC Guide 1.86 has gained widespread acceptance as a guide for establishing decontamination limits even though it is titled "Termination of Operating Licenses for Nuclear Reactors."

(5) Industrial Chemical Criteria

OSHA Standards, Limits for Chemical Substances in the Work Environment as specified by the American Conference of Governmental Industrial Hygienists and the NIOSH Toxic Substances List provide exposure limits for workers. Such areas which contain toxic materials in the work environment in excess of these limits have to be decontaminated to ensure safety to a future work force either while occupying the building during the workday or while performing maintenance, buildings modification, or demolition.

2. Background.

a. Location and Description of Frankford Arsenal.

Frankford Arsenal (FA) is located in the northeast section of the city of Philadelphia. It is bounded by Frankford Creek on the south, the Delaware River on the Southeast, Bridge Street on the west, Tacony Street and I-95 Interstate Highway on the north and industrial concerns on the northeast. Rohm & Haas is located across Frankford Creek from the installation. A map of Frankford Arsenal is contained in Figure 2-1 and an aerial view of the installation is presented in Figure 2-2. The installation comprises approximately 110 acres and contains 212 buildings (see Figure 2-3).

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[7] OCE Draft Engineering Pamphlet (EP) 405-1-900, "Real Estate," Chapter 13, Control and Disposition of Contaminated Land.

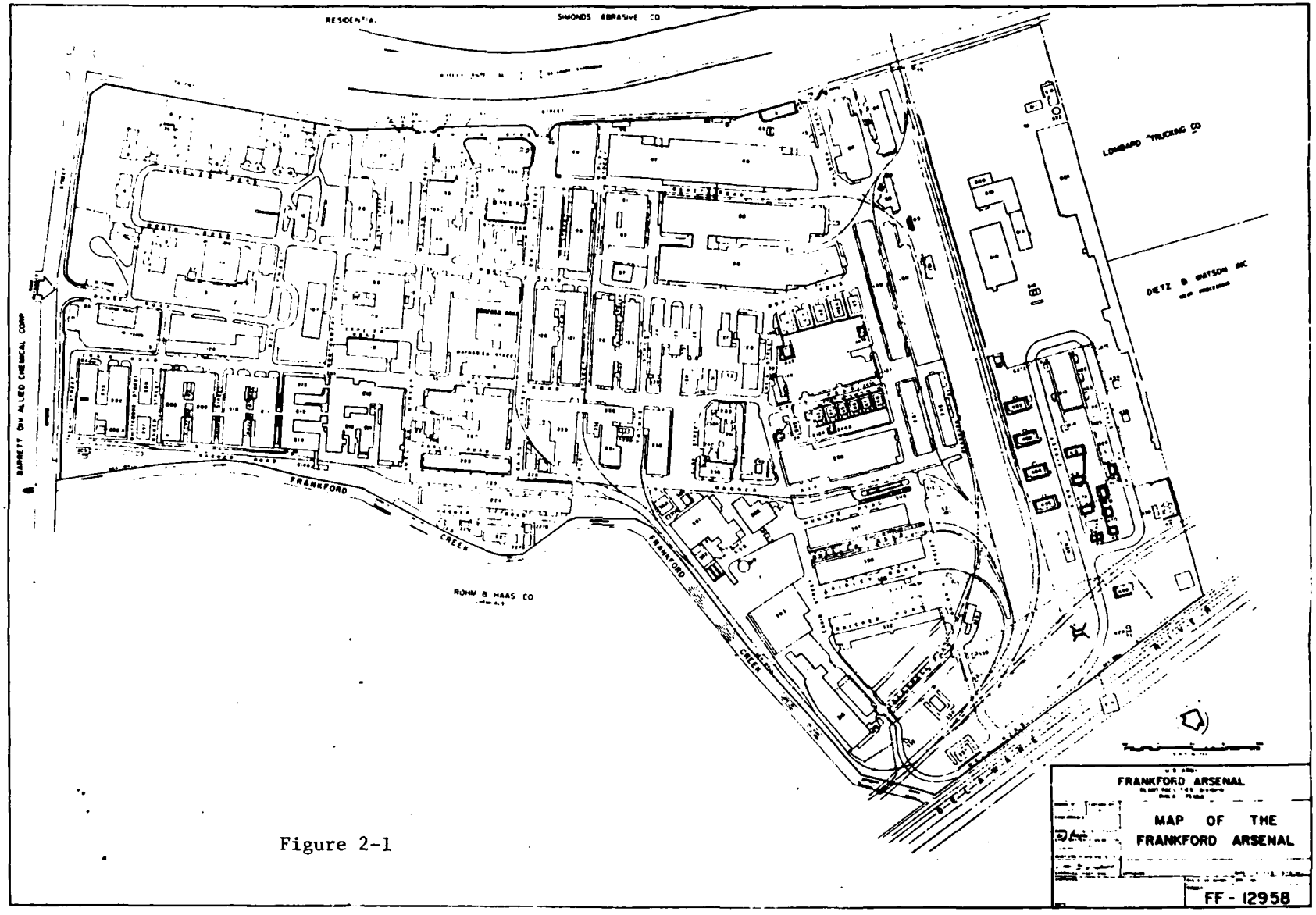
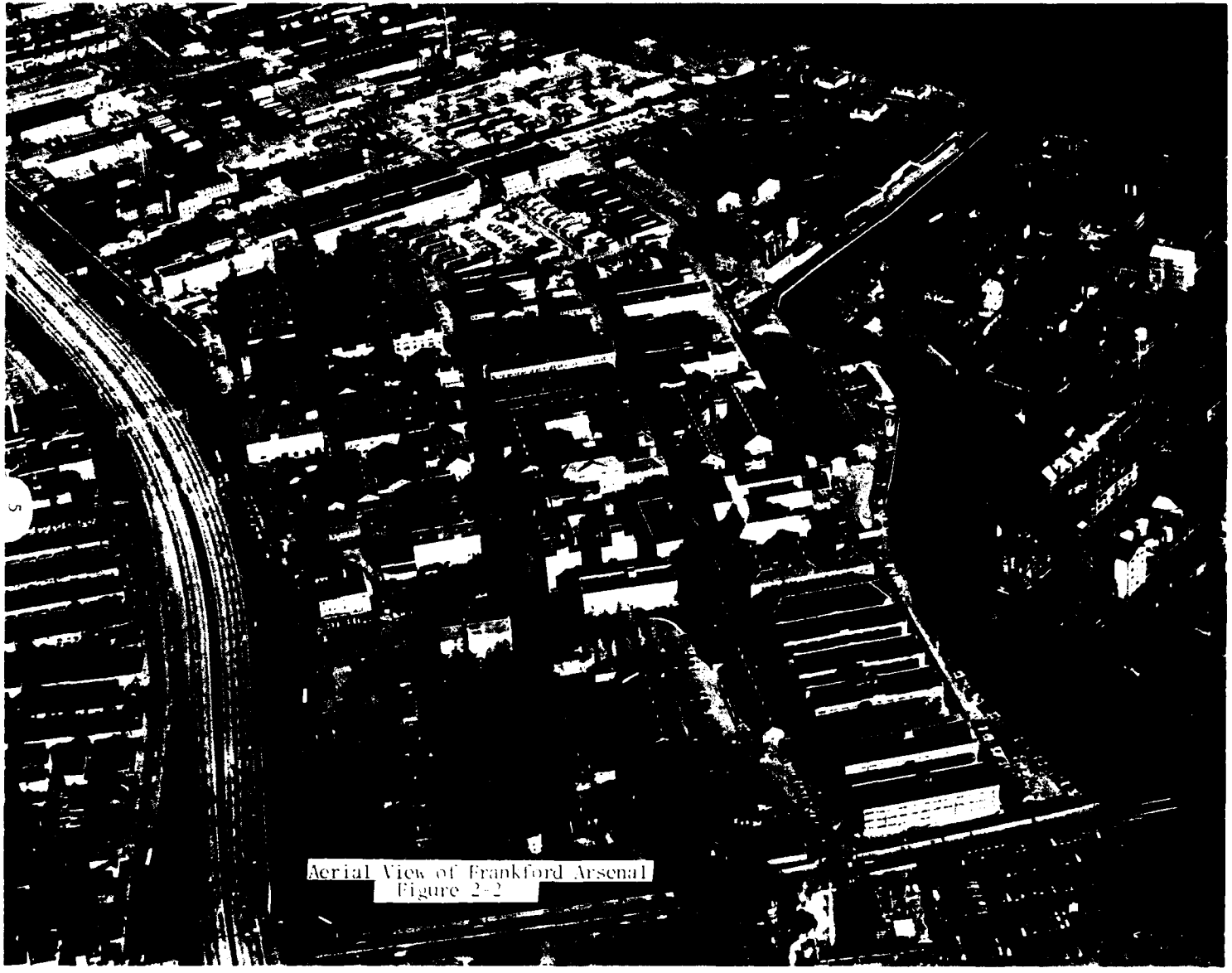

RESIDENTIAL
SIMONDS ABRASIVE CO
LOMBARD TRUCKING CO
DIETZ & WATSON INC
BARRETT DIV ALLIED CHEMICAL CORP
FRANKFORD CREEK
ROHM & HAAS CO
FRANKFORD ARSENAL
MAP OF THE FRANKFORD ARSENAL
FF - 12958

Figure 2-1



Aerial View of Frankford Arsenal
Figure 2-2

As of June 1977

FRANKFORD ARSENAL FACILITIES

Land Area ..... 110 acres

	NUMBER	GROSS BUILDING AREA (MILLION SQUARE FT)
TOTAL BUILDINGS	212	2.59
PERMANENT TYPE CONSTRUCTION	120	2.41
SEMI-PERMANENT	56	.12
TEMPORARY TYPE	36	.05

COST DATA (AS OF 30 JUNE 1976)	ACQUISITION COST	CURRENT REPLACEMENT VALUE
LAND & IMPROVEMENTS	$ 1.6 MILLION	$ 14.7 MILLION
BUILDINGS, STRUCTURES & UTILITIES	50.9 MILLION	229.8 MILLION

Figure 2-3

Prior to the decision to close the Arsenal, the FA mission was to research, develop, design, engineer, procure, supply and/or service military material in the performance of National Support and Special Missions, on specified materiel, equipment, and systems. This resulted in a wide range of explosive, pyrotechnic, radiological, and other hazardous substances being present at FA.

FA operated as a commodity center for small caliber munitions, cartridge activated and propellant activated devices; related test and handling equipment; and multipurpose testing equipment. Research was also conducted in the fields of Optics, Metallurgy, Material Degradation, Tracers, and Laser Countermeasures. The Arsenal also performed procurement for assigned commodities and for fire control materiel. It performed support mission responsibilities for artillery shell metal parts and cartridge cases, mechanical time fuzes and mechanical timing devices; as well as for fire control materiel in support of US Army Field Units.

b. History of Arsenal.

On 27 May 1816 approximately 20 acres of land were acquired by the Federal Government from Frederick Fraley for $7,680.75. The land was to be used as a general storage and distribution depot for ammunition, small arms, artillery, and cavalry equipment. Shops were built during the war with Mexico to repair artillery and infantry weapons, as well as the proofing and testing of musket and rifle powder.

Following the procuring of the Fraley tract, FA was expanded by the acquisition of the Kennedy tract in 1837, the Haines tract in 1849, the Lenning tract in 1917, and the Fitler tracts in 1943 and 1951 (see Figure 2-4).

In 1853 the first power driven machinery for the manufacture of percussion caps, bullets, cartridges, and other small arms ammunition items was introduced to FA.

In 1892 Captain Pitman was assigned to FA to conduct research on smokeless propellants. He was followed in 1894 by Captain Beverly Dunn who was instrumental in initiating research work in explosives at the installation. The Pitman-Dunn Laboratories were named in honor of these men.

During World War I, FA continued to carry out depot and supply operations. Small arms ammunition production increased to 60,000,000 rounds during the war.

In World War II greater emphasis was placed on .50 caliber ammunition. The Arsenal developed new types of ammunition, prepared drawings and specifications for other suppliers and conducted extensive proof testing. It was also heavily involved in R&D work in the commodity areas of fire control instrumentation and small arms ammunition, and to some extent, artillery ammunition shell and cartridge cases.

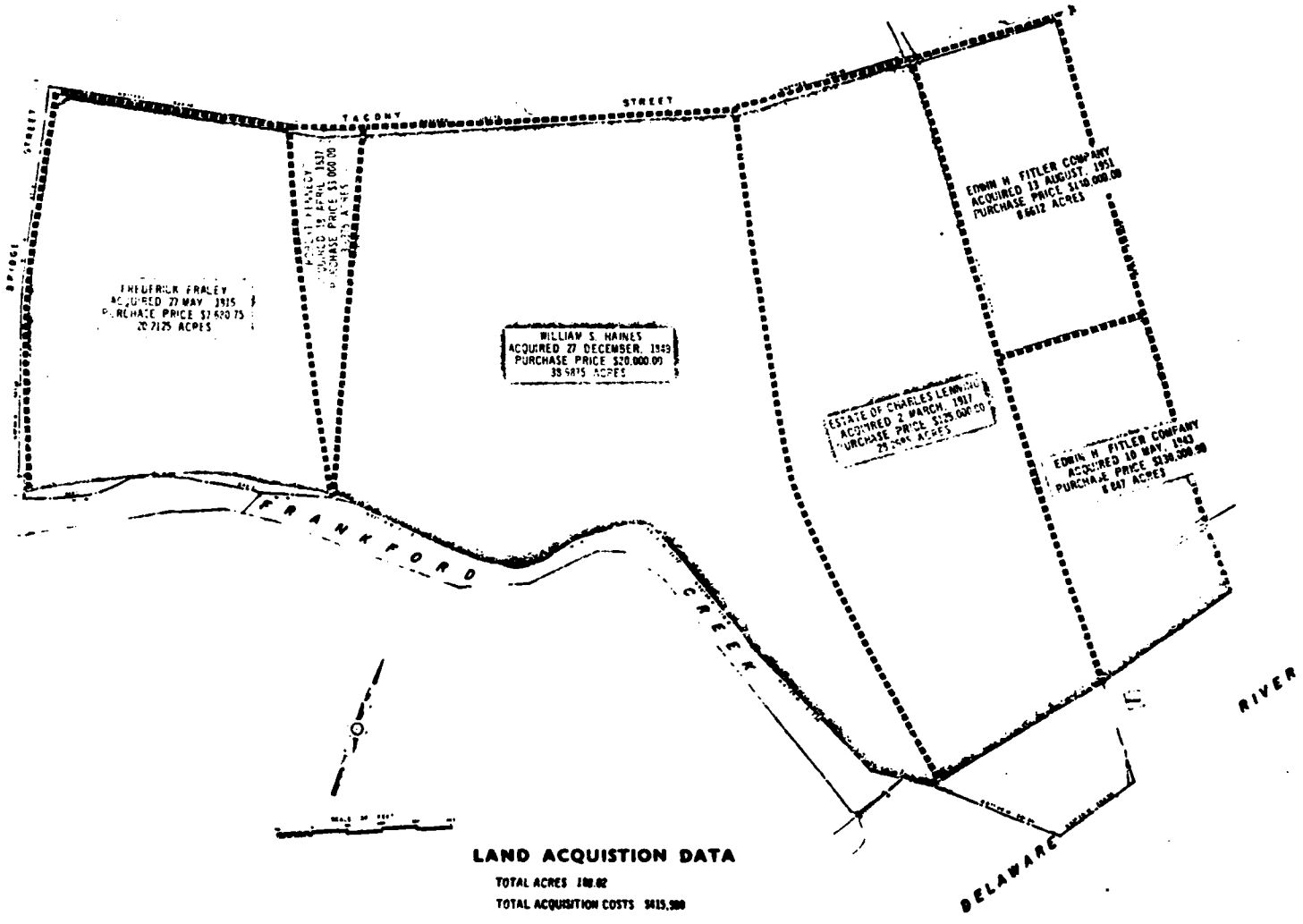

TACONY STREET
FREDERICK FRALEY
ACQUIRED 27 MAY 1915
PURCHASE PRICE $7,620.75
20.7125 ACRES
WILLIAM S. HAINES
ACQUIRED 27 DECEMBER, 1949
PURCHASE PRICE $20,000.00
35.5875 ACRES
EDWIN H FITLER COMPANY
ACQUIRED 13 AUGUST, 1951
PURCHASE PRICE $140,000.00
8.6612 ACRES
EDWIN H FITLER COMPANY
ACQUIRED 10 MAY, 1943
PURCHASE PRICE $130,000.00
8.847 ACRES
FRANKFORD CREEK
DELAWARE RIVER
LAND ACQUISTION DATA
TOTAL ACRES 100.02
TOTAL ACQUISITION COSTS $415,500

Figure 2-4

In 1976 the Arsenal was reported as excess to Army needs. Currently, political efforts are being made to have industry and/or Government utilize the Arsenal. This tract contains approximately 20 structures including the original headquarters and barracks buildings.

c. 400 Area.

(1) Description and Size

The "400" Area is a nine acre section of FA located in the southeast end of the post. This land was acquired in 1943 and is known as the Fitler Area, after the former owner, a rope manufacturing company. The area is fenced and contains 35 buildings located along Phillips and Kirk Streets (see Figure 2-1). The 400 Area was used to manufacture primer mixes and pyrotechnic materials (see Figure 2-5). Lead styphnate manufacture was started in 1944 and production continued to 1976. Areas of contamination include 35 one and two room buildings, associated drains, traps, sumps, and approximately 8,200 feet of terra cotta drain lines. The drain lines include branch waste lines from each building's sump and the main 30" line running to the Delaware River. Wash down of process areas and decanting of vessels during operations contributed extensively to contamination of the sumps and drain system; however, the extent of contamination is unknown at this time and must be defined prior to selecting decon methods. It is anticipated that soil surrounding pipe joints is contaminated, also.

(2) Primer Manufacturing Process

Components of the primer mix are tetrazine (guanyl nitrosamino guanadine) and lead styphnate (mono hydrate lead salt of 2,4,6 trinitroresorcinol: styphnic acid). Both components were manufactured within the 400 Area.

Styphnic acid was manufactured in Building 415 via the sulfonation of resorcinol, in batch reactors of nominal 30 liter size, and subsequent nitration using nitric acid and anhydrous sodium nitrite, the nitrite salt being freshly dried in an oven in Building 414. The product styphnic acid was then packaged in wooden boxes and stored in Building 415.

The lead styphnate was made by the batch precipitation of a mixture of styphnic acid and lead nitrate-acetic acid solution stored in Building 417. The batch operations in Building 417 were performed in 60 liter containers. The batch size of normal lead styphnate was approximately 2 pounds. Daily production rate was approximately 100 pounds, and the material was stored in Building 429. The process was originally purchased from the Olin Corporation and is also the basis for the Twin Cities design. Lead styphnate was stored, wet, in Building 430.

Tetrazine was manufactured in Building 427 via the batch precipitation reaction of sodium nitrite with amino guanadine bicarbonate solubilized in

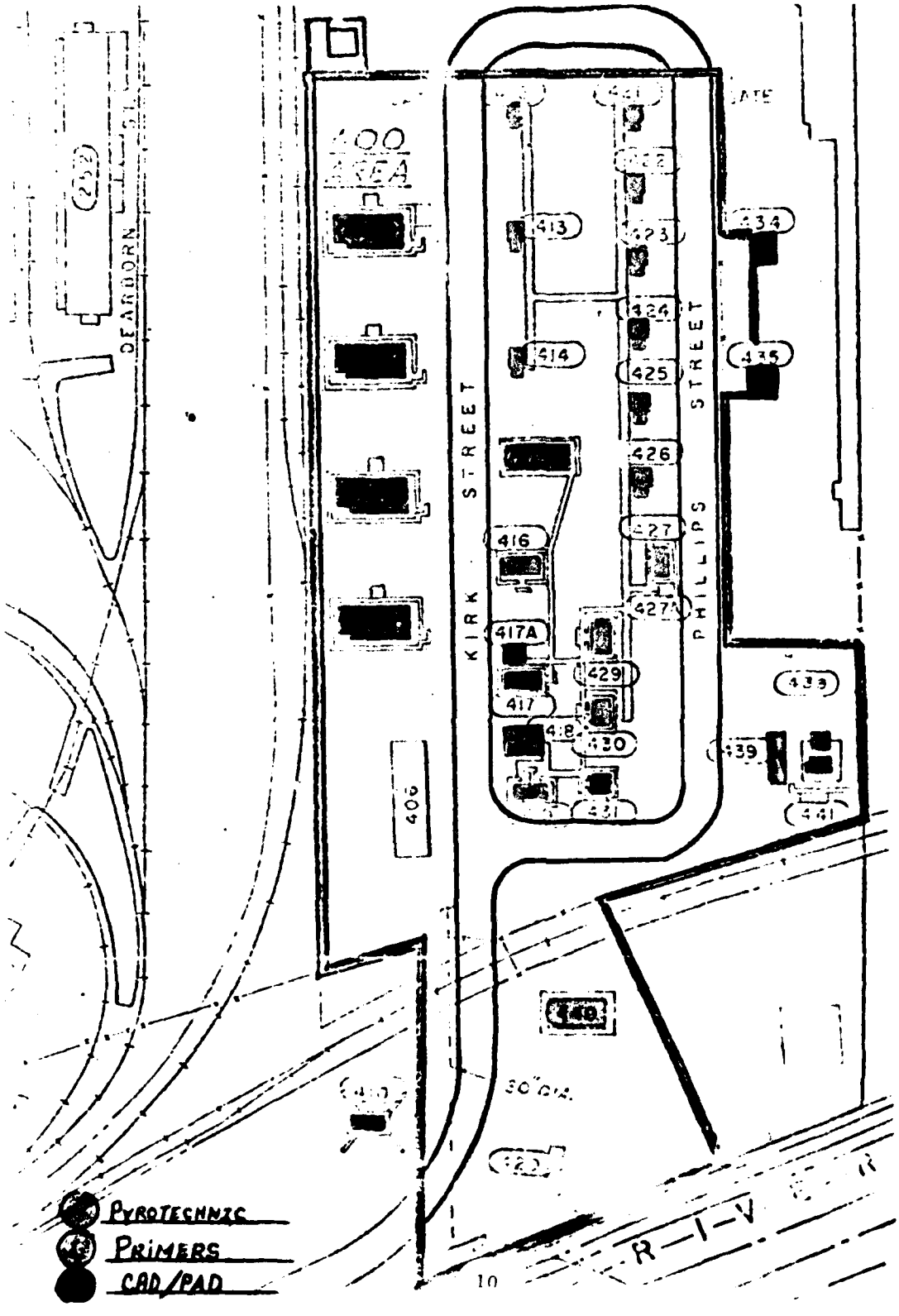


Figure 2-5 400 AREA

aqueous acetic acid. The reactor size was a nominal 60 liters and the reaction time was approximately twenty-four hours.

Pentaerythrite Tetranitrate (PETN) was stored in Buiding 145 and 146 (surface structures removed) and was transferred to Building 427 for weigh-up. Prior to its use, it was washed several times to remove the alcohol solution it was kept under. Weigh-up of the styphnate and tetrazine was performed in Building 430 in preparation for blending. Blending took place in Building 419 where 700 gms of lead styphnate was combined with 650 ml of tetrazine slurry. To this mix was added other components (e.g., antimony sulfide, powdered aluminum, PETN, barium nitrate and a light gum binder), the proportions of the additives determining the primer mix, 956, 982, etc. The final mix was stored in Building 410. When required for insertion into primer cups, the primer mix was transferred in 7.5 pound batches to Building 222.

The disposal of off specification lead styphnate was initiated in Building 418 where the material was hydrolyzed with 50% NaOH and the lead removed by the precipitation as lead acetate. Spilled and excess primer mix from Building 222 was also returned to the 400 Area for disposal in the sumps.

(3) Propellants, Propellant Activated Devices (PAD) and Cartridge Activated Devices (CAD).

The process for the auxiliary ignition for the PAD and CAD was conducted in Buildings 414, 416, and 418.

In 416, 120 grade Zirconium powder (6.125 gms) was mixed with lead dioxide (18.125 gms) in distilled water. The mixture was then aspirated to remove the water. Drying of the material was accomplished in Building 414. (Building 414, the support analytical laboratory, was also involved in testing and experimental activities using nitrocellulose and nitroglycerine.) The final mixture was prepared in Building 418 where the zirconium-lead dioxide was combined with methylene chloride and a binder supplied by the Navy. This blend was then hand "painted" into ring shaped cups. The propellant material was stored in Building 440, with additional rooms designated for the canning process with distribution of cans made from other rooms.

(4) Pyrotechnics

Pyrotechnics were blended in Buildings 413 and 422 in an Abby blender and a handcaster, respectively. Many specialized mixes were prepared using such materials as barium nitrate, magnesium and aluminum powders, potassium perchlorate, iron oxide, red phosphorus, strontium peroxide, strontium nitrate, strontium oxalate, and calcium resinate binder. The materials were stored in Buildings 425 and 426. The incendiary materials were dried in Building 424 and 425 and the pyrotechnic materials were pelletized in Building 423. Building 422 was also the site of the blending of experimental delay mixes.

(5) Chemical and Explosive Storage and Support Buildings

Buildings 402, 403, and 405 were storage magazines for primer materials; 404 was used for propellant storage. Building 421 was used for TNT storage.

Building 412 was the chemical storage area for Zirconium and sodium carbonate. Building 417B, 426, and 427B were used for the bulk chemical storage of the fuels or oxidizers utilized in the primer mix.

Commercial black powder was stored in Building 431. It was also sublotted into 12.5 pound quantities in this building. Building 420 was also used for powder storage.

Buildings 434 and 435 were the sites of bullet and case break-up.

Building 438 was an open burning pit and 439 was the area of the ammunition and explosives incinerator and retort. The scrap was held in Building 441 for incineration.

Building 406 is an office building and formerly a personnel activities area.

d. Unexploded Ordnance (UXO).

Although there are presently no active burial sites at FA, information obtained during interviews with present and former employees indicated that explosive ordnance was formerly buried within the boundary of the Arsenal (see Fig 2-6).

(1) Baird Street Gate: During the early Fifties Civil War ordnance rounds were found when digging in the area near the Baird Street entrance during construction of the fence and gate. Actual numbers and types of rounds recovered were not available; however, interviewed personnel indicated that the rounds were not inert and that a large quantity was found.

(2) Catapult Construction Adjacent to Building 316: During construction of the catapult (Building 319), ordnance rounds from World War I were found when the foundations were dug. The ordnance were live artillery rounds and were found at two separate locations: under what is now an asphalted parking lot (northeast of Building 316) and the southeast corner of Building 316 where the catapult structure now stands. Building 316 was used from World War I to the present to test artillery ammunition.

(3) Caves: North of Craig Road and south of the 140 series of buildings was an area known as the caves. Although it is now a parking lot, the area was formerly a series of underground caves where ordnance was tested. Personnel interviewed expressed the opinions that all of the munitions were probably not removed when the area was backfilled for construction of the parking lot. No indication was received of the quantity and types of ordnance rounds buried at this site. Buildings 145 and 146 were formerly in this area.

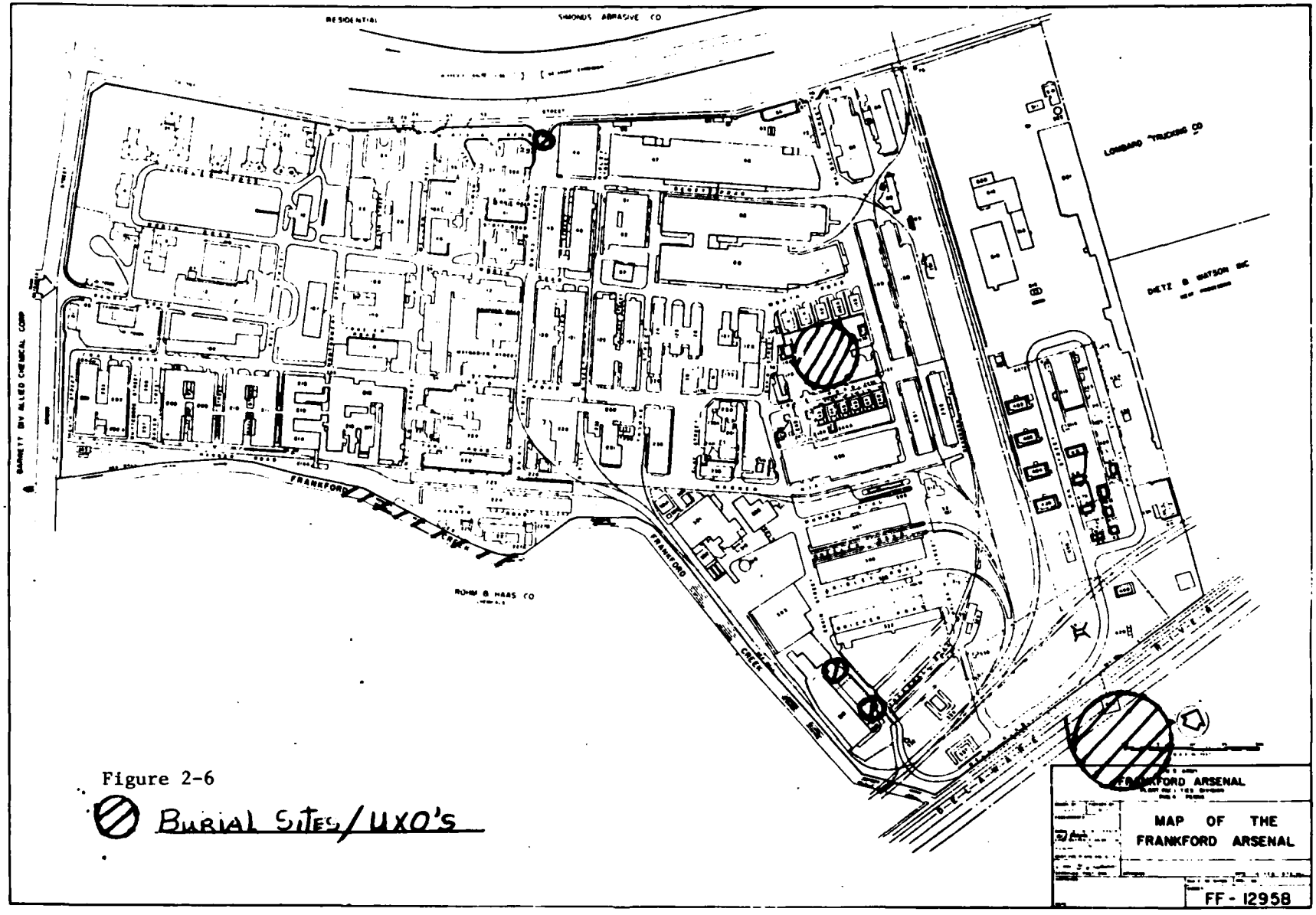


Figure 2-6

Burial Sites / UXO's

(4) Delaware River at 409 Pier: The 409 pier on the Delaware River was used to load barges and ships with ammunition prior to World War II. Personnel interviewed indicated that ordnance was dumped into the Delaware River off the pier.

(5) Frankford Creek: Considerable small arms ammunition was apparently thrown into the creek by FA personnel. The interviewees talked of throwing cartridges at birds on the fence and the cartridges landing in the creek. They talked in terms of "thousands of cartridges." Frankford Creek also formerly had a dock where barges were loaded with ammunition for shipment.

(6) Delaware River: During testing at the old outdoor range (parallel to Dearborn Street), many test rounds were reported to have missed the berm backstop and impacted into the Delaware River. The range was used from prior to the Civil War to 1954.

e. Explosive/Pyrotechnic Contamination.

FA has approximately 50 buildings, excluding the 400 Area, potentially contaminated with explosive, propellant, and pyrotechnic material. This contamination consists primarily of dust accumulations in air conditioning and ventilation ducts, fans, floors, ceilings, and walls. However, in some cases, contamination of drain lines and sumps is also expected. Table 2-1 identifies the buildings which are considered potentially contaminated and provides a brief description of the contamination which is present. Buildings which are contaminated or potentially contaminated with explosive, propellant, and pyrotechnic materials are color coded on the Arsenal map in Figure 3-1.

f. Radiological Contamination.

The programs at FA involving radioactive materials include: depleted uranium; self-luminous sources; optical shop (thorium in glass); watch testing; and radioisotopes lab work (see Table 2-2).

(1) Depleted Uranium: Depleted uranium (DU) was used in the fabrication and testing of explosive devices. DU was received in Building 44 and then sent to a storage or processing area. Storage areas included Buildings 149, 150, 227B, 307, 312, and transportainers 28 and 126. It is believed that "special projects" used Building 123 and the balconies in Buildings 55 and 58 as DU storage areas. Building 307 was used as a shipping area for DU.

The major uranium processing was carried out in Building 149. This building contains an induction heated vacuum melter. High levels of contamination may exist in this apparatus and its associated ducts and equipment.

The major DU machining took place in Building 150 in a special shop for DU. Other machining took place on the third floor of Building 210 which was apparently decontaminated between 1965-70. It is believed that machining

TABLE 2-1

FRANKFORD ARSENAL
EXPLOSIVE/PYROTECHNIC CONTAMINATION

BLDG	ACTIVITY	DESCRIPTION	CONTAMINANTS
46			
68-E	Prototype component fabrication and lab sampling of pyrotechnic materials, pyrotechnic changing and storage.	Weighing, blending, and loading equipment.	Various chemicals, fuels, oxidizers for tracer mixes.
68-W	Test and evaluation of propellants, pyrotechnics, and initiating explosives.	Analytical and special test apparatus, sinks, catch basins, drains, lab hoods, including ventilation system.	Various chemicals, including acids, solvents, mercury.
69	Explosive storage.	Various type containers.	High explosives.
120	Surface treatment and finishing.	Anodizing unit including processing tanks, piping, drains, etc. Ventilation system. Small calb. loading.	Various acids, corrosives, primers, and propellants.
122	Special small arms ammo (20 & 30 mm) loading, assembling, and packaging.	Primer insert and cartridge case loading machines.	Primers and propellants.
147A	Explosive storage.	High explosive mag.	High explosives.
148	Long term storage of ammo/components at evaluated temperature.	Conditioning chambers, rooms, cells.	Propellant explosives residue, etc.
148A	Explosive storage.	High explosives mag.	High explosives.
151	Pyrotechnic material. Research engineering.	Machine tools, test equipment--including ventilation system, protective shells, etc.	Pyrotechnic compositions.

FRANKFORD ARSENAL
EXPLOSIVE/PYROTECHNIC CONTAMINATION (CONTD)

BLDG	ACTIVITY	DESCRIPTION	CONTAMINANTS
151A	Process storage.	Racks, shelves, bins, etc.	Pyrotechnic elements.
208	Small arms bullet charging.	Charging machines, individual cubicles, auxiliary equipment, scales, hand loaders, etc.	Igniter compositions, propellants, black powder, primers.
209	Special ammo. Loading and assembling tracer charging and basing.	Charging and loading machines including auxiliary equipment, scales, hand loaders, etc.	Igniter compositions, propellant, black powder, primers.
212-2	Mercurous cracking.	Mercury processing tanks, basins, drains, piping, and ventilation systems.	Mercury, acids and corrosives.
212-3	Small arms primer inserting, includes staging.	Primer inserting machines and associated equipment.	Small arms primers.
213-3	Special projects. Loading and assembling to include	Primer inserting, loading machines, and auxiliary equipment.	Primers and propellants.
214	Small arms cartridge loading.	Loading machines and auxiliary equipment.	Propellants.
214A	Propellant staging.	Racks, containers.	Propellants
219	Small caliber loading.	Loading machines.	Propellants
221			
222	Small arms primer mfg and caseless ammo fabrication.	Primer cup charging, power presses, dryers, ventilation systems, special machinery, fixtures, etc. for caseless ammo. Process storage equipment.	Primer composition, primers, propellants.

FRANKFORD ARSENAL
EXPLOSIVE/PYROTECHNIC CONTAMINATION (CONTD)

BLDG	ACTIVITY	DESCRIPTION	CONTAMINANTS
224	CAD/PAD loading, assembly, and packaging.	Special fixtures, devices for manual loading, assembling, and packing.	Igniters, propellants, and cartridges for CAD/PAD.
227	Analytical and inspection.	Test equipment, devices, etc.	Propellants.
228	Small caliber production.	Charging and loading machines.	Igniter compositions, propellants.
229	Special items, materials fabrication, process staging.	Solvent processing equipment, drain systems, racks, hoods, ventilation, etc.	Propellants, solvents, toxic materials, etc.
240	Small arms break-up shop.	Various items and equipment.	Propellants, requires clean-up.
241	Explosive storage	High explosives mag.	High explosives.
242	Caseless ammo. Complex research and fabrication.	Presses, grinders, special fixtures, sumps, drains, and ventilation systems.	Solvents, toxic material, propellants.
243	Storage - primers, dry house.	Misc. inert items, equipment, materials.	Primer residue, etc.
244	Storage primer, dry house, propellants research and fabrication	Part of caseless ammo, research and photo manufacture.	Primer and propellants.
244	Storage	Containers.	Propellants.
245 & 246	Same as 244	Various equipment related to propellant manufacture.	Propellants and chemicals.
247	R&D operations on propellants.	Chemical processing equipment.	Chemicals related to propellant manufacture.
248	R&D test operations.	Slave manipulator and auxiliary equipment.	Propellant and component charges.

FRANKFORD ARSENAL
EXPLOSIVE/PYROTECHNIC CONTAMINATION (CONTD)

BLDG	ACTIVITY	DESCRIPTION	CONTAMINANTS
249	Tracer and delay mixes - storage	Conductive containers, shelves, racks, etc.	Tracer mix and delay compositions.
250	Fuse assembly shop - storage cubicles.	Special fixtures, shielded tables, containers, etc.	Primers, relays, detonators, boosters, propellants.
301A	CAD/PAD test areas (includes test tower).	Various test fixtures for ballistic testing of catapults, etc.	Both completed assemblies and breakdown items, including cartridges.
305	Fuze environmental test area.	Various test fixtures.	Complete fuzes.
311	Fuze drop test tower.	Drop test fixtures and equipment.	Fuzes.
316 & 319	Ballistic research range and tower.	Test fixtures, equipment, ventilation system.	Various charged assemblies, cartridges, propellants, etc.
332	Storage magazine (cave).	Containers, etc.	High explosives.
334	Storage magazine (above ground)	Containers, etc.	High explosives.
337	Storage magazine.	Containers, etc.	Propellants, etc.
339	Storage magazine.	Containers, etc.	Nitroguanidine.
521	Small arms and special ammo proof testing range.	25 proof test ranges, firing and test equipment.	Small arms ammo, propellants, primers, lead, and toxic materials.

TABLE 2-2

FRANKFORD ARSENAL
RADIOACTIVE MATERIAL CONTAMINATION

BLDG	DESCRIPTION	CONTAMINANT
23	Storage, lab	Radium and others
44	Receiving	Various - all
45	Processing - threading	Depleted Uranium (DU)
55	Processing - grinding	DU
57	Health Clinic	Check sources, instr.
58 (Bal)	Machining	DU
64	Lab	DU and other
106	Environmental test	None - tritium
108 (1 & 2)	Optical shop	Thorium
108 (3 & 4)	Processing - assembly	Tritium
108 (Basmt)	Storage	Tritium
109	Computer - Fire Alarm	Radium
112	Packaging	Tritium
116	Storage, packaging	Tritium
123	Assembly	DU
148A	Storage ammunition	DU
149	Processing	DU
150 (1st Flr)	Machining	DU

FRANKFORD ARSENAL
RADIOACTIVE MATERIAL CONTAMINATION

BLDG	DESCRIPTION	CONTAMINANT
150 (2nd Flr	Watch shop	Radium - Tritium
150, Range	Firing	DU
201 (1st Flr)	Lab	Tritium, Promethium, etc.
201 (2nd Flr)	Office, counting room	Tritium and other
202, Vault	Storage	Various
202	Office area	Tritium
202	Watch lab (same as vault)	Radium, Tritium
208	Leak testing (radiflow)	Krypton
210	Machining	DU
225	Storage	DU
227B	Storage	DU and other
230	Environmental test	Tritium
231	Environmental test	Tritium
245	Storage, ammunition	DU
305	Environmental test	Tritium
307	Shipping - storage	DU - other

FRANKFORD ARSENAL
RADIOACTIVE MATERIAL CONTAMINATION

BLDG	DESCRIPTION	CONTAMINANT
312	Radioisotope lab	Various
316, Range C	Firing	DU
507	Storage	DU
513	Processing (swedging wire)	DU
519	Watch shop	Tritium
521, Range 16	Firing	DU

took place in Building 55 and 58 balcony. DU wires were swagged in Building 513.

DU rounds were fired primarily in Building 316, range C and only limited firings were done in Building 521, range 16. The major laboratory work was conducted in Building 64. Some work was also performed in the radioisotope laboratory in Building 312.

(2) Self-Luminous Sources: Tritium gas sources sealed in glass tubes were the most recent self-luminous sources used; however, other isotopes were previously used and include promethium-147 and krypton-85.

The principal laboratory area is located in Building 201, first floor, and the instrumental counting room is located on the second floor. Sources are also located in the vault area of Building 202.

Fire control instruments containing tritium devices were stored in Building 116 and Building 108, third and fourth floors, and the basement. Fire control maintenance was accomplished in Building 116. Building 108 (third and fourth floors) were used for the assembly of tritium devices in the fire control instruments and quality control testing of the instruments. Packaging of fire control instruments was done in Building 112 (first floor).

(3) Optical Shop: A large optical shop for grinding and assembling lenses for fire control instruments was located in Building 108, first and second floors.

(4) Watch Testing: The watch shop was first located in Building 202 and then moved to Building 150, room 222, in 1960. Tritium and radium watches were tested in these areas. In 1970 the shop moved to Building 519 where only tritium watches were tested. In 1976 all environmental testing was moved to Building 230. Additional environmental testing was done in Buildings 106 and 305.

(5) Radioisotope Lab Work: The old radioisotope lab was formerly located in Building 312. All of the radioactive materials and equipment, including lab benches and sinks have been removed. Other radioisotope work was done in Building 64, second floor, with radium-226, zinc-65, polonium-210, cobalt-60, and silver-110. Radium-226 was also used in Building 23.

g. Industrial Chemicals:

Contamination also exists in various buildings as a result of the extensive use of toxic organic and inorganic chemicals. Buildings 47, 48, 55, 58, and 215 were utilized for chemical treatment of metal parts. Plating was accomplished in Building 119 and tool hardening utilizing cyanide was performed in Building 217. Mercury was employed in Buildings 64, 68, and 212. Lead was extruded in Building 216. Various organic and inorganic chemicals, including acids and solvents were used throughout Building 64.

3. Technical Approach.

a. Technical Approach Overview.

(1) Project Elements: The contamination picture at FA is portrayed in Figure 3-1. Based on this data, the FA IR project has been divided into five separate decontamination project elements; a sixth project element covers supporting documentation preparation. The six project elements are:

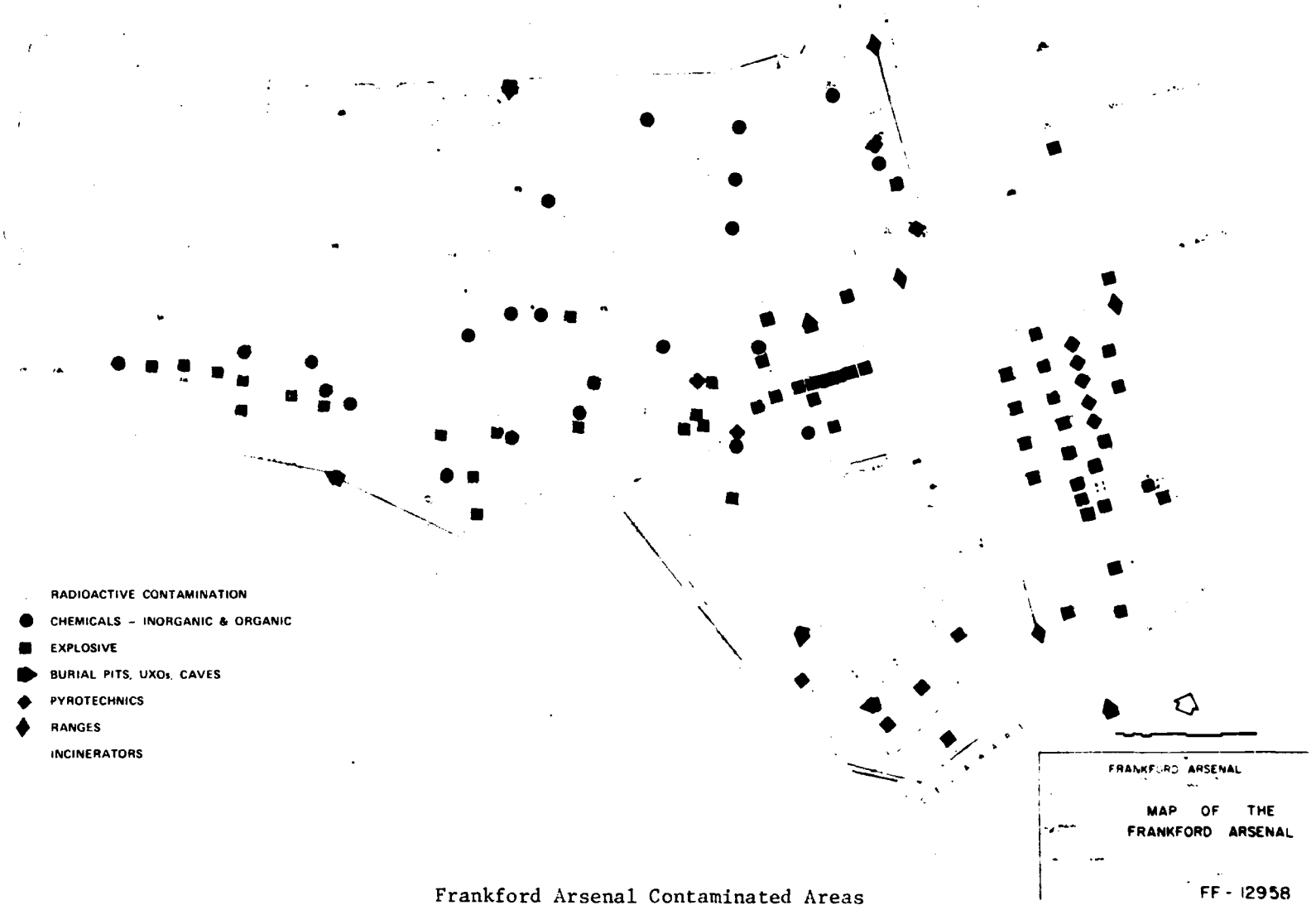
400 Area
Unexploded Ordnance (UXO)
Explosives/Pyrotechnics Materials
Radiological Materials
Industrial Chemicals
Supporting Documentation

The programmatic structure for the project is shown as Figure 3-2.

Because of the large amount of data available about the 400 Area, plans for the decontamination of this area have been developed to a far greater detail. The 400 Area is addressed as a distinct element of the project because it is the area which was most recently acquired by the Army (1943) and, as such, the work conducted in this area is far more completely documented than the other areas of the Arsenal. In short, it represents a rather well defined problem. When it is decontaminated and when minor efforts are accomplished in the 500 Area, a 17.5 acre tract will be available for release to the General Services Administration.

In the cases of the other project elements, the effort is being defined in terms of the type of problem rather than by the particular tract of interest (i.e., Radiological, UXO, etc.). The radiological problem, for instance, spans all Arsenal areas but the 400 series of buildings.

(2) Decision to Decontaminate: Within the UXO, Explosives/Pyrotechnics, Radiological, and Industrial Chemicals project elements, there is a decontamination decision point reached prior to actual decontamination work being accomplished (see Figure 3-2). At this point technological constraints; regulatory requirements; land and facilities values; costs of care, custody, and maintenance; decontamination cost estimates; zoning restrictions and other factors (including historical, socioeconomic, and political) are to be weighed prior to making a decision to commit funds for decontamination. Because a decision in one project element may impact on another project element, there is only one decision point in time. (For example, if radiological decontamination is justifiable because of high care and custody costs associated with radiologically contaminated areas, this may turn out no longer justifiable if care and custody costs have to be incurred for maintenance of other portions of the Arsenal, thereby spreading the cost.)



Frankford Arsenal Contaminated Areas
Figure 3-1

FIGURE 3-2

FRANKFORD ARSENAL IR PROJECT ELEMENTS

400 Area	UXO	Explo/Pyro	RAD	Industrial Chemicals	Supporting Documentation
Decon Method Decision Data Base	Tech Data Gathering	Tech Data Gathering	Initial Health Physics Survey	Industrial Chemicals Survey	Procurement Document
Sump Samp & Anal	Trenching Data Eval	Buildings Eval			Synopsis
Env Rqmts Def	Avail Tech Eval	Decon Criteria			Cost Estimate
Trans/Final Disposal Study	Interim Operations	Decon Verif Test Methods Dev			TDP
Decon Methods Stdy	#316 Cross Trench	Geotechnical Investigation			Orientation Plan
	Pier 409				
Soil Decon Verif Method	Frankford Creek	Decon Prog Development			Variance/Permits
Fitler Sewer Cont Eval	Cave				EIS/EIA
Geotechnical Investigation	Baird Street Gate				Public Affairs Plan
Decon Prog Development					
		D E C O N T A M I N A T I O N D E C I S I O N P O I N T			Land Release/Decon Decision Report
Decon Operations	UXO Removal Operation	Decon Operations	Decon	Decon	Land Clearance Statements
			Final Health Survey	Final Industrial Chemicals Survey	

The result of this analysis is to be a "Land Release/Decon Decision" Report. This effort is depicted on Figure 3-2 under the Supporting Documentation project element; the relationship to decision points within the other project elements is denoted by the solid lines running across the figure.

It is presently believed that the 400 Area (and the adjacent 500 Area) represents a situation where decontamination and release to GSA are justified aside from decisions made on the decontamination of the remainder of the Arsenal. When the 400 Area is decontaminated and when minor actions are accomplished in the 500 Area, a 17.5 acre tract of prime industrial property will be available. This tract would have access to the City of Philadelphia and major highways to the north, be bordered by railroad on the west, and possibly have the Delaware River shipping channel to the south.

(3) Criteria for Decontamination: In the cases of radiological and industrial chemicals elements, there exists quantitative decontamination criteria. For example, AR 700-64 prescribes the maximum permissible radiological contamination in work areas. In a case where depleted uranium operations were conducted, fixed contamination cannot exceed 5,000 dpm per 100 cm^2.

In paragraph 1c, criteria for decontamination were discussed for explosives materials. However, this criteria is general in nature. In decontaminating buildings and soil contaminated with explosives and pyrotechnic materials, these general criteria must be transformed into specifics and, where possible, quantitative standards required to ensure safety. Decontamination will then be measured against and verified by comparison to this criteria. In all cases the levels to be achieved in the decontamination of the various buildings and areas that comprise Frankford Arsenal will be the levels necessary to document that decontamination has proceeded to a point which will assure safety to the general public when property is released.

b. Technical Approach - 400 Area.

(1) Subelements: This program element is divided into three subelements: Decon Method Decision Data Bases, Decon Program Development and Decon Operations. The objective of this program element is to eliminate the explosive and pyrotechnic safety hazards in the 400 Area. To accomplish this objective, buildings, sumps, drain lines, and contaminated soil must be decontaminated and removed.

Because buildings contain floor drains which must be removed, extensive damage of the buildings will result. The 35 buildings in the 400 Area are all small one or two room structures and have little value. It will likely be easier to destroy the buildings than to attempt to retain structural integrity and decontaminate. Decontamination of the buildings in place also results in costs to verify decontamination which are not yet justified. For these reasons the efforts for the 400 Area assume building demolition.

(2) Decon Method Decision Data Base: One acceptable method for explosives decontamination is flashing of any surfaces or materials suspected of being contaminated. This is, therefore, a potential method for achieving decontamination of the 400 Area. However, this may not be a viable alternative because of the environmental problems which could be encountered by essentially "open burning" within the City of Philadelphia. Open burning is prohibited unless a variance is obtained from the City Department of Health.

The decon method decision making process is described graphically in the logic diagram shown in Figure 3-3. This decision making process can be moved through as: environmental data, information on transportation restrictions, information on the potential for off-site decontamination, and data on chemical, as well as other decontamination procedures becomes known. This data is generated by the accomplishment of the tasks contained within the Decon Method Decision Data Base Subelement. These tasks are discussed below.

(a) Sump Sampling and Analysis:

Buildings in the 400 Area have drain sumps adjacent to them. These sumps were used to catch materials washed down the floor drains. Additionally, there is a large sump just prior to the final discharge point at the Delaware River. Visual examination indicates that the sumps have a significant amount of sludge in them. However, visual examination can give no estimate of the hazard associated with the sumps. This task will provide some necessary and basic analytical data upon which other 400 Area tasks will build. Presently no such data is available.

Samples will be taken from each sump and analyzed for the various explosive and pyrotechnic materials expected to be present. The constituent present will be defined and the amount present determined. This data will then be used to estimate the safety hazard associated with sump clean out and removal. The results of the sampling and analysis will also provide basic data necessary for conducting the Environmental Requirements Definition Task and the Transportation/Final Disposition Task. (These two tasks are discussed in (2)(b) and (2)(c), respectively.)

DECON METHOD DECISION LOGIC DIAGRAM

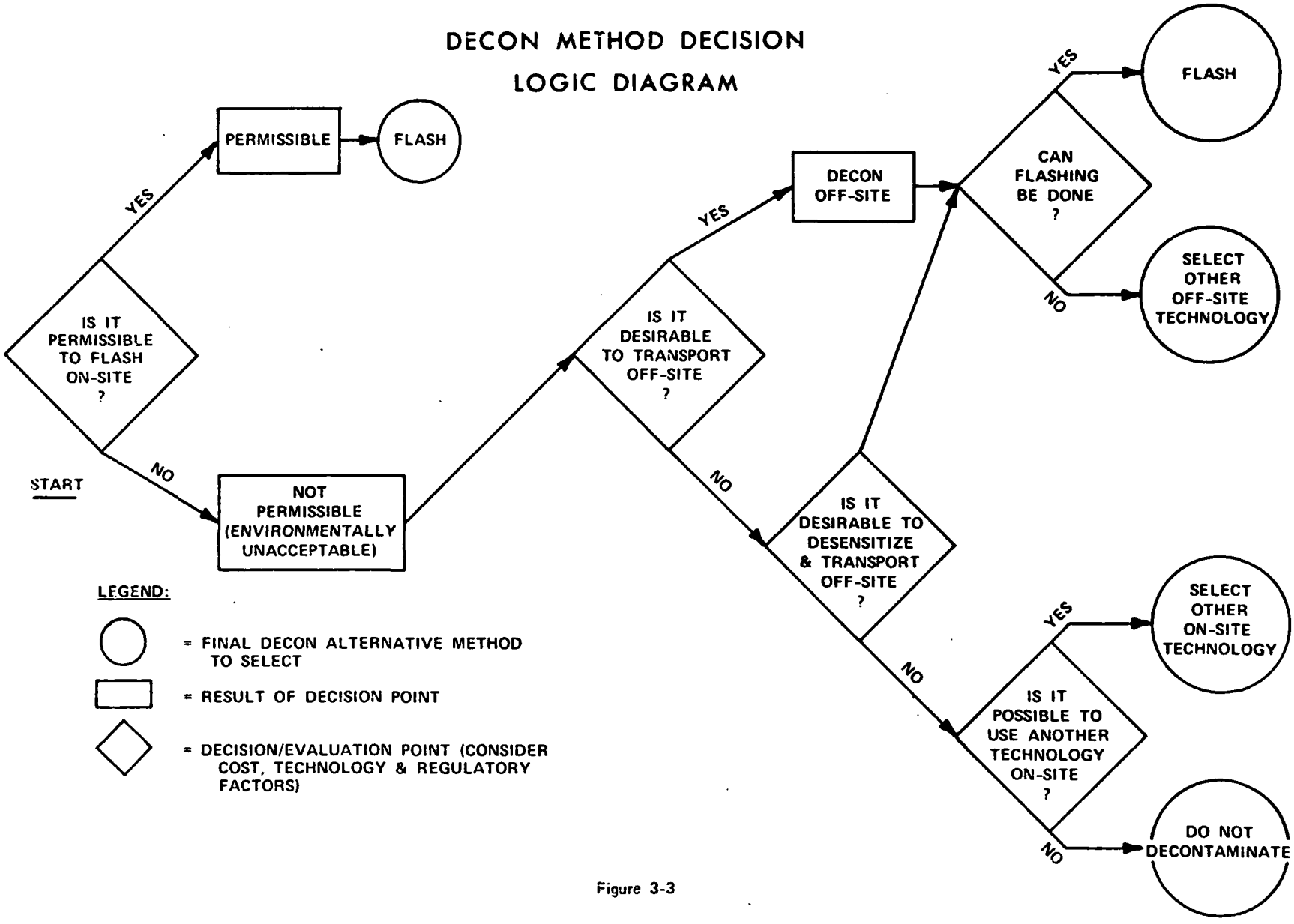


Figure 3-3

Additionally, tests on candidate desensitizing methods will be performed on sump samples to evaluate their effectiveness. This information may be useful if it is desirable to desensitize explosives materials before removing them from the sumps for final neutralization. It may also be desirable to flush buildings or process waste lines with a desensitizing solution prior to removal.

Samples will be available for full scale neutralization testing if this is required, based upon the inability to flash. These studies will be aimed at selecting the best desensitizing techniques and varying concentrations, temperature and reaction time to achieve complete neutralization. These parameters would then be optimized in the lab for use in the field in a full scale reactor.

(b) Environmental Requirements Definitions: An accepted method for accomplishing explosives decontamination is burning (flashing). Within the 400 Area there are 35 small buildings, 8,200 feet of piping, and most likely, quantities of contaminated earth which will require decontamination. The amount of burning allowed with the restrictions placed on it must be defined. The City of Philadelphia prohibits open burning except when a variance can be obtained from the Department of Health (FA currently has a variance).

Other alternative decontamination techniques including chemical neutralization or explosive/demolition are available and will be investigated. However, because significant quantities of high pH liquids and dissolved metals would be involved, direct discharge of waste solutions would not be permitted. The requirement for pretreatment prior to waste discharge or sanitary landfill will be defined.

The purpose of this task is the establishment of limits for the discharge into air and/or water of contaminants generated during decontamination operations. The information necessary to enable the preparation of requests for variances for open burning and discharge permit application will be obtained. This effort is to be based on Federal, state, and local air and water statutes, estimates of the quantities of materials present, and knowledge of techniques for effluent pretreatment and burning control. The task will include contacting EPA Region III, the State of Pennsylvania Department of Natural Resources, and the City of Philadelphia Department of Health.

(c) Transportation/Final Disposition: Based on environmental limits and other considerations, it may be necessary or desirable to remove explosives contaminated materials from the Frankford Arsenal site. This task required that transportation off-site of contaminated materials, both with and without desensitizing, be investigated. The determination of where off-site decontaminantion by flashing of materials could be accomplished is also to be performed.

Finally, whether decontaminated materials present a final disposal problem is to be studied. This information would be required if concentrated waste products resulting from a controlled burning process or from chemical decomposition are to be present and, therefore, must be disposed of in an environmentally acceptable method. Whether or not disposal at the place of decontamination presents an environmental problem must be determined.

(d) Study of Decontamination Methods: This task will study methods available to control particulate emission from open burning operations, should only a controlled burning be allowed. Should flashing either on or off-sites not be considered a viable alternative, another decontamination technique would have to be utilized. This task also has as its purpose the investigation of other potential decontamination techniques.

Chemical decomposition is the most likely technique. There are known decomposition methods; however, these have not been utilized in a large scale effort. Some information on these methods is to be obtained during the performance of the Sump Sampling and Analysis task. Additional data would be obtained in this task.

Chemical decompositon, as opposed to flashing, has the added requirement of decontamination verification associated with it. Where materials are flashed, decontamination is considered certain. However, if chemical neutralization is employed, test data demonstrating the effectiveness of the the method of decompositon and/or results of samples taken after decontamination reactions demonstrating that no hazard remains would be required. (In all cases, including flashing, it is necessary to substantiate the details and parameters of the actual decontamination work in order that certification of decontamination can be made.)

This task also involves the evaluation of other possible decontamination processes. These would be more technology intensive and expensive techniques such as simultaneous demolition and decontamination by the select placing of explosive charges or the use of fluidized bed combustion technology available to ARRADCOM. Should application of these techniques be required, the lead time for beginning decontamination effort would be increased significantly.

(e) Soil Decontamination Verification: As a final requirement of decontamination, it will be necessary to verify soil decontamination. After contaminated piping is removed and decontaminated, what is considered to be contaminated soil will also be removed. It is highly likely that explosives materials have leaked through the terra cotta pipe joints and are now contained in the soil. It will then be necessary to verify that complete decontamination has occurred and no safety hazard remains. Soil samples will need to be tested in the field to allow additional soil removal to be accomplished immediately if the testing detects unsafe soil contamination levels.

Within this task the following will be accomplished:

1 Safe levels of explosives and pyrotechnic materials in soil will be established.

2 A test method will be developed to test soil to assure that safe levels have been achieved. This will be a field verification method.

(f) Fitler Sewer Evaluation: The 400 Area was purchased in 1943 from the Fitler Rope Company. The old Fitler sewer line to the Delaware River runs alongside of the contaminated drainage system. It is believed that this piping is not contaminated, but this is not certain. This task requires the checking of the Fitler line to see if there is a presence of explosives material. Should contamination be present, the Fitler sewer decontamination will be added to the decontamination work scope.

(g) Geotechnical Investigation: Sampling of ground water and soil will be conducted.

(3) Decontamination Program Development: The results of the tasks within the Decontamination Method Decision Data Base subelement will enable the plan for accomplishing decontamination to be developed. This will consist of: establishing the sequence of decontamination operations, preparing approved SOPs for the decontamination operation, developing plans for treating and monitoring pollutants, and carrying out a pre-operational survey prior to the decontamination and discharge of effluent into the air and/or water.

A possible sequence for decontamination of the 400 Area is discussed below. This is only a possible scheme. The data obtained from the Decontamination Method Decision Data Base subelement will actually shape the approach or approaches.

Chemicals would be added to the sumps to desensitize explosive material as much as possible by chemical means and then the sumps would be pumped out, keeping the material wet at all times. Sump material could then be reacted at an elevated temperature and with a high enough concentration of reactant to assure complete decomposition. Decomposition would be verified. Pretreatment of liquid waste and subsequent environmentally acceptable disposal of solids and liquids would occur.

Empty sumps could next be used to catch decontamination solution from buildings. This decontamination would result in removal of most of the explosives dust. The buildings could then be demolished and rubble burned onsite (if a variance is obtainable from the city) or transported elsewhere for burning. Burning would be low in all but particulate emissions (unless some devices to control burning were used (because the majority of the contamination would have been removed in the washing.

Contaminated drain lines in the buildings which run to the sumps would then be flushed with desensitizing solution and then removed by protected machinery and flashed. Decon solutions would again be collected in the sumps. All chemical wastes would have to be reacted to ensure decomposition of explosives and pyrotechnic materials, decomposition verified, and then pretreated to remove toxic metals and to obtain an acceptable pH.

The remaining problems would then be the removal of the 8,200 feet of pipe and the removal of contaminated soil. Because of the presence of the sumps and due to the fact that water was constantly run through the system, it is not expected that the pipes are heavily contaminated. The quantity of decon solution required to flush these pipes, as well as the likely low effectiveness of using these solutions at ambient temperatures and safe handling concentrations, might warrant straight pipe removal rather than flushing first. The potential for loss of large quantities of decon solution through the terra cotta pipe joints, as well as the increase in soil contamination this would cause, must also be considered. However, not flushing the lines first increases the risk of serious detonation. Removal would have to be accomplished by well shielded vehicles. Men would not be allowed in the trenches.

The removed pipe may require flashing and the contaminated soil may have to be removed and flashed. Soil decontamination verification would then take place.

(4) Decontamination Operations: Decontamination operations will comprise removal of contaminated piping and sumps, decontamination of structures and removal of contaminated soil. The contract technical data requirements and other procurement-connected aspects required for accomplishing these operations are discussed in the Supporting Documentation portion of Technical Approach (Section 3g). Contractual work will actually begin with the Decontamination Program Development subelement and continue through the completion of decontamination.

c. Unexploded Ordnance (UXO).

(1) Subelements: Although there are no records of ordnance burial or dumping, interviews with current employees and retired employees indicate that UXOs have been found while doing the excavation for several construction projects in the central portion of the Arsenal. There is also a potential for UXO off the pier in the Delaware River and in Frankford Creek.

The Unexploded Ordnance element of the project is divided into three subelements: Technical Data Gathering, Interim Operations, and Total UXO Removal Operations. The Technical Data Gathering subelement is composed of two tasks: Trenching Data Evaluation and Available Technology Evaluation. Interim Operations contain a task associated with each of the suspected UXO areas.

(2) Technical Data Gathering:

(a) Trenching Data Evaluation: An evaluation of building foundations and soil borings data for the entire Arsenal will be made. The purpose of this study is to establish the depth that foundations were placed at and locate boring points. This data will be placed in the form of a trenching map because, in effect, the foundations represent the trenching of significant portions of the Arsenal. The need for additional data in areas immediately surrounding suspected UXO burial locations will be determined as will areas where there is too little information to be confident about the absence of UXO.

(b) Available Technology Evaluation: An evaluation of the Army and Navy technology in the area of UXO detection and removal will be made. This information will help define the next two subelements of the project: Interim Operations and Removal Operations. The study also has as a major purpose the clear definition of what the limits of detection are. This information is essential to the decision making for defining Removal Operations and for the language required in land clearance statements.

(3) Interim Operations: The search for UXOs will be performed on a limited basis in each suspected area. This will possibly substantiate data obtained from employees and will better define the areas of concern. Failure to find evidence of UXOs will be evaluated in light of technology availability to determine if more sophisticated devices could be utilized to assist in detection.

The tasks to be accomplished in this subelement are: cross trenching around Building 316; digging into the cave below the 140 series parking lot; magnetometer sweeping of the old outdoor firing range; digging into the area around the helipad; searching the area around the 409 pier; searching Frankford Creek; cross trenching in other areas as necessitated by the results of Trenching Data Evaluation task; and searching the area around the Baird Street Gate.

(4) Removal Operations: All areas where previous work has indicated the presence of UXOs would be fully decontaminated using available technology. Limitations of the search due to available technology, problems associated with underwater detection or sweeping, and other considerations will be so noted. A plan will be developed for action to take upon discovery of unexpected UXOs.

d. Explosives/Pyrotechnics.

(1) Subelements: During the course of modern day operations (World War II through 1977), many of the buildings located at Frankford Arsenal have been contaminated with propellant, primer, and pyrotechnic materials.

In most cases, buildings are contaminated only with dusts. This presents a decontamination problem for floors, ducts, walls, and rafters. There are typically no floor drains in the manufacturing areas and they appear to represent the bulk of the effort in terms of number of buildings. However, problems associated with the drains in Buildings 240 through 248, and Buildings 239 and 249 are expected; these buildings have been used for propellant, pyrotechnic and primer research work, and in the processing and blending of pyrotechnics and primers. A final consideration is land areas where burning operations were conducted.

The efforts within this project element are based on the assumption that, because in many cases large manufacturing buildings are believed to have only single floors or only a few bays contaminated, it is not desirable or cost effective to destroy these buildings. Buildings of little value which have suspected sump and drain line contamination will be handled in the same manner as were buildings in the 400 Area.

The approach taken and described in the following sections is: all buildings, sections within buildings, sumps, drains, areas adjacent to buildings which are possibly contaminated and burn areas will be decontaminated to levels which ensure that no hazard exists regardless of whether buildings are used as is, renovated, or demolished in the future.

The subelements of the Explosives/Pyrotechnics project element are: Technical Data Gathering, Decontamination Program Development and Decontamination Operations. The Technical Data Gathering subelement is composed of the following four tasks: Buildings Data Evaluation, Decontamination Criteria Development, Sampling and Analysis, and Decontamination Verification Test Method Development.

(2) Technical Data Gathering: The decontamination of manufacturing buildings must be conducted utilizing methods which will not destroy the structural integrity of the buildings. Physical cleaning methods such as vacuuming and chemical washes can be employed to gather up dusts (wet vacuuming would be necessary to preclude an explosives safety hazard). Ducts and flooring will have to be ripped out to assure complete explosives removal in these areas which are the likely places where explosives or pyrotechnic materials would have accumulated during years of operations.

Before this decontamination can be accomplished, several areas of data must be developed:

1 All areas of contamination or suspected contamination must be defined.

2 The criteria by which an area will be considered acceptable for release must be defined in specific and quantitative terms.

3 The procedure for verifying decontamination must be developed. The tasks that are discussed below have been developed to fill this data gap.

(a) Buildings Evaluation: Records on operations at Frankford Arsenal prior to World War II are limited. Based on information available from World War II to the present, there are 50 buildings (excluding the 400 Area) known or suspected of being contaminated with explosives, propellants, or pyrotechnic materials. There is a concern over other buildings and areas of buildings not considered contaminated, but which are old enough to have possibly been used for small caliber ammunition manufacturing prior to World War II.

Two efforts are required. First, all available information on building age and usage must be correlated (the ages of buildings are color coded in Figure 3-4). This effort should clearly remove many of the approximately 200 buildings from concern. Then, the remaining buildings must be carefully examined both visually and by sample taking. These two efforts should define the areas of decontamination to be addressed. This list of buildings or sections of buildings to be decontaminated is expected to be sizeable.

(b) Decontamination Criteria Development: The criteria to be used in judging an area as being safe for release to the general public must be developed specifically. AR 405-90 states when addressing contaminated industrial property that areas must be cleared of those dangerous and explosive materials reasonably possible to detect either by careful search or by visual examination. These criteria must be applied by developing specific requirements for assuring decontamination. This requirement should be based on a combination of:

1 The inherent explosive or other hazard of material.

2 The geometry of the situation (explosive spread over a large flat area is not a problem; however, that quantity of material blown into a corner may very well be hazardous).

3 A detailed procedure for visual examination.

4 Sampling and analysis.

(c) Decon Verification Test Method: Decontamination Criteria Development and the verification of decontamination itself relies on an acceptable method of sampling and analysis for explosives, propellants, and pyrotechnic materials. This task requires the development of a field check for effectiveness of decontamination.

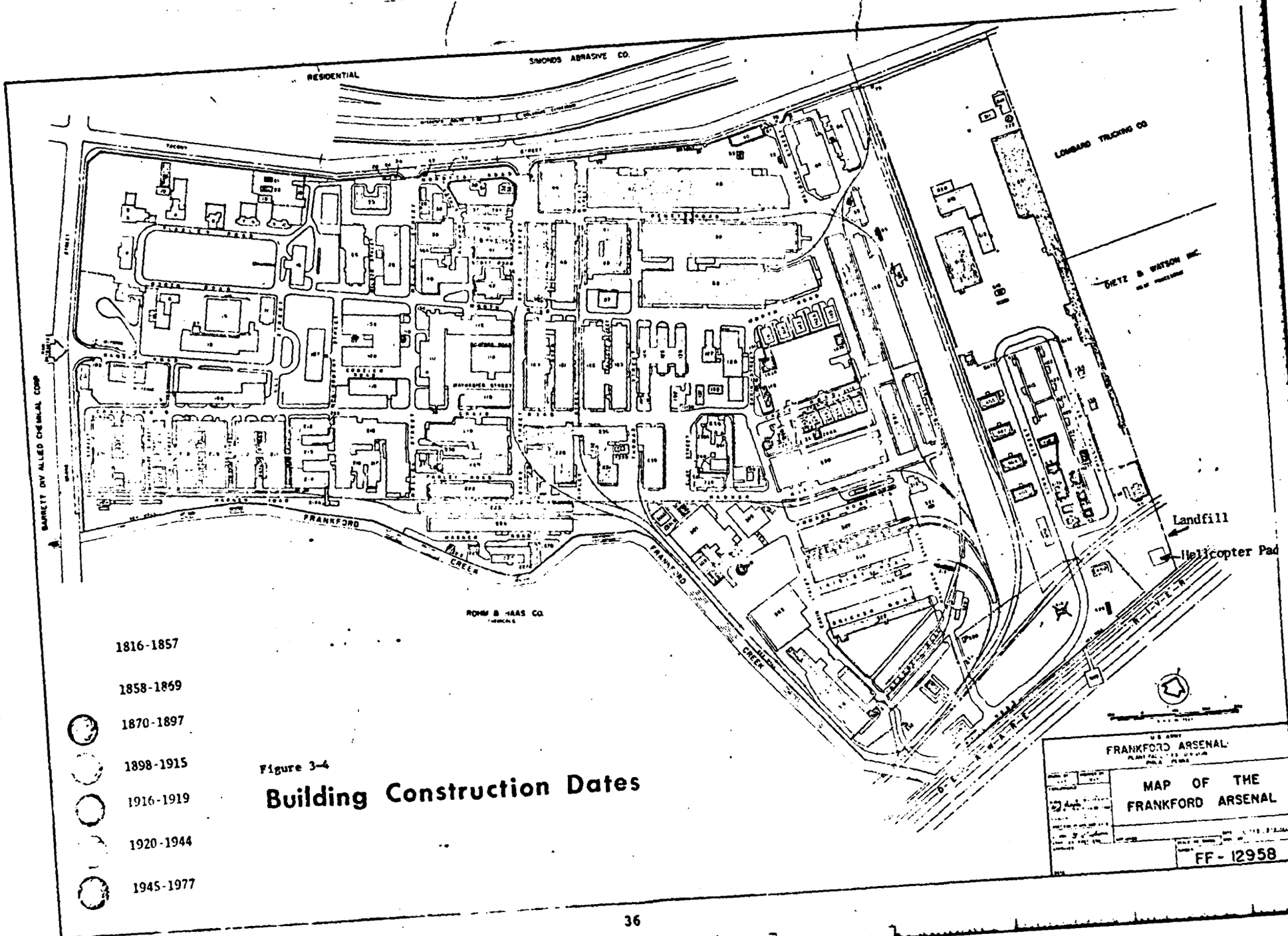


Figure 3-4

Building Construction Dates

This method will also be of benefit in surveying areas which are not likely to be contaminated. In effect, the method for sampling and analysis as part of the four requirements previously noted, can be used to satisfy requirements for release of buildings and area without decontamination operations being performed.

(d) Geotechnical Investigation: Sampling of ground water and soil will be conducted.

(3) Decontamination Program Development: This subelement will result in the utilization of existing or the development of safety SOPs, the procedures for decontamination operations, and plans for handling the wastes generated by decontamination operations. This subelement will accomplish the specification of how each building will be decontaminated. Decision on the value of saving the building itself will be made. The potential effects on building structural integrity when sumps and lines are to be removed will also be considered.

(4) Decontamination: Decontamination operations will comprise removal of contamination from floors, walls, rafters, ducts, sumps, and adjacent land areas. Decontamination will be followed by tests verifying the level of decontamination achieved. From this data, clearance documents can be prepared (this is covered in Section 3g(7)).

e. Radiological Contamination.

Twenty-five buildings at Frankford Arsenal contain or have the potential to contain radiological contamination. In some cases entire buildings are involved; in other cases, just small areas within buildings are contaminated or suspected of being contaminated. Regardless of whether the contamination is known to be present, is suspected, or is most likely not present, a health physics survey of all these areas is required.

Because the contaminants in question vary from building to building (uranium, thorium, radium, tritium), the types of instruments used and lab analyses to be performed will also vary. For instance, tritium is best detected by taking smears of the area suspected of being contaminated and then counting the smears in a liquid scintillation device, while uranium might initially best be detected by using an instrument or a scintillation probe containing a sodium iodide crystal.

The radiological contamination project element is divided into the following three subelements: Initial Health Physics Survey, Decontamination, and Final Condition Health Physics Survey.

The initial survey would define the contamination present or prove the lack of it. For contaminated areas the scope of the decontamination would then be defined.

Decontamination is known to be required in the foundry and machinery areas located in Buildings 149 and 150, and the firing range C of Building 316. In these areas ducting will be a major problem. The other areas confirmed as being contaminated by the initial health physics survey will be decontaminated also.

Once decontamination has been accomplished, a final health physics survey will be required to document the adequacy of decontamination.

f. Industrial Chemicals Problem Areas:

Several buildings are known to have been used in operations where various toxic organic and inorganic chemicals were employed. The most serious problems are the two buildings (64 and 68) contaminated with mercury (additionally, a room in Building 212 is potentially contaminated with mercury). Other areas are of concern because toxic metal salts and cyanide solutions were used and the drains are likely to be highly contaminated.

There are 12 buildings questioned as being contaminated with toxic substances; all will require survey. Only in three is there a high likelihood of decontamination being required. However, prior to decontamination, an analysis will be made whether decontamination can be made without destroying the structural integrity of the buildings and whether decontamination without demolition is cost effective in view of the limited application land/facilities value and operating costs.

Buildings cannot be released if the exposure future workers would experience, either in demolition or in actually working in the buildings, is above OSHA or other limits. The approach employed will be identical to the approach to the radiological problem; i.e., initial industrial chemicals survey, decontamination, and final industrial chemicals survey.

In any cases where evidence of soil contamination is found, analysis will be performed to determine levels of the contaminant in soil. These levels will then be used in a pathways-to-man analysis to estimate the health hazard associated with contaminated areas. Should there be a health hazard, the contaminated soil would be removed to an acceptable burial area, such as Class 1 landfill.

g. Project Supporting Documentation.

(1) Subelements: This element of the project describes the documents that are reuired in support of the program. Preparation of each of the

following six documents or groups of documents represents a project subelement: Procurement Documentation, Variances and Permits, EIA/EIS, Public Affairs Plan, Land Release/Decon Decision Report, and Land Clearance Statements.

(2) Procurement Documentation: All decontamination work will be contracted to private industry; some survey work will also be contracted. To accomplish this, the following tasks will have to be accomplished.

(a) A synopsis or several synopses will have to be prepared and published in the Commerce Business Daily.

(b) Scope(s) of work will have to be prepared.

(c) Technical proposal evaluation plans will have to be prepared; this would include the assembly of the necessary technical expertise into a proposed evaluation team.

(d) Needed technical data will have to be assembled, summarized, and duplicated for dissemination to prospective quoters.

(e) Contract data requirements will have to be defined. A requirement for data management will be written into every contract so that data generated from the program can be stored in a computer bank. This data will be utilized for future decontamination of other installations.

(f) Plans for orientation programs and visits to FA for prospective quoters will have to be developed.

(3) Variances/Permits: The status of present FA Variances/Permits for storage, demolition, burning, water quality discharge, etc. will be established, and needed Variances/Permits applied for or updated as required. Based on discussions, meetings, and agreements with Federal, state, and city agencies, a permit covering allowable discharges into the Delaware River and/or Frankford Creek will be prepared. This will be a National Pollution Discharge Elimination System (NPDES) permit.

Open burning in the City of Philadelphia is not permitted unless a variance is obtained from the City Department of Health. Requests for variances will be prepared and provided to the Commander of FA for forwarding to the City of Philadelphia.

(4) EIS/EIA: An Environmental Impact Statement will be prepared. However, presently it appears that only an assessment is required. Although content will be identical, several months can be saved if the staffing and publishing of an EIS is not required. Should the decision be that an EIS is required, all proper staffing will be accomplished. Supplements to the EIS/EIA will be added as new facts are discovered which affect the original EIS/EIA.

This document will be signed by PM CDIR and the Commander of FA and/or the Commander of ARRCOM, as appropriate.

(5) Public Affairs Plan: This plan will be prepared in advance of the EIA/EIS completion. It will be available in advance of any public discussion (such as at city council meetings) of request for variances to the open burning prohibition. This document is vital in view of the press coverage the closure of FA has received. The Public Affairs Plan, as well as the EIA/EIS, will include required information on the historical tract at FA. Supplements will be added to the Public Affairs Plan, as necessary, to keep it current.

(6) Land Disposal/Decontamination Strategy: In order that decisions on decontamination and, therefore, on release of portions of the Arsenal are not made on a piecemeal basis, the decision points in the 400 Area, UXO, Explosives/Pyrotechnics Decontamination, Radiological Decontamination, and Industrial Chemicals elements of the program should be reached together. This will result in a Land Use Decontamination Decision Analysis which takes into account land values; care, custody, maintenance and other costs; technical considerations; restrictions necessary on the release of any portions of the FA tract; zoning restrictions; and socio-economic/political considerations. The result will be a strategy for land release.

This document will also establish a schedule for the clearance of various parcels of land. This schedule is to be coordinated with GSA if it is desirable to sell off portions of the Arsenal at different times rather than to sell the entire tract at once.

(7) Land Clearance Statements: All necessary statements with backup information will be prepared in accordance with AR 405-90 for signature of the Commander of FA or the Commander of ARRCOM, as appropriate.

4. Cost and Schedule.

a. General. This section of the plan provides an estimate of the cost and time to accomplish the FA decontamination project; it is based on the technical approach outlined in Section 3. Since firm estimates for conduct of actual decontamination operations are dependent on the results of the technical data gathering efforts, funding requirements and program schedules included in this plan represent initial estimates and will, therefore, require revision as initial project tasks provide results.

It is projected that the various data gathering tasks will be accomplished by a combination of DOD and contractor efforts. Decontamination operations will be performed by contract with private industry with the possible exception of UXO removal, which may be performed by the Department of the Navy.

b. Schedule.

(1) Overview: The proposed schedule for decontamination of FA is contained in Figure 4-1. The schedule indicates by a bar, the month each project subelement is initiated through the month of planned completion. The solid bar represents the expected project schedule based on Department of the Navy capability to perform UXO removal and Department of the Army capability to perform the evaluation of the extent of building contamination which is part of the Explosives/Pyrotechnics Project element. A revised schedule will be prepared at the end of Phase I, Technical Data Base Development, as the problems become more defined.

(2) 400 Area: Completion of the 400 Area decontamination is projected for 34 months after project approval and funding. This date is based on obtaining the necessary permits and variances and having completed an EIS prior to award of the decon contract.

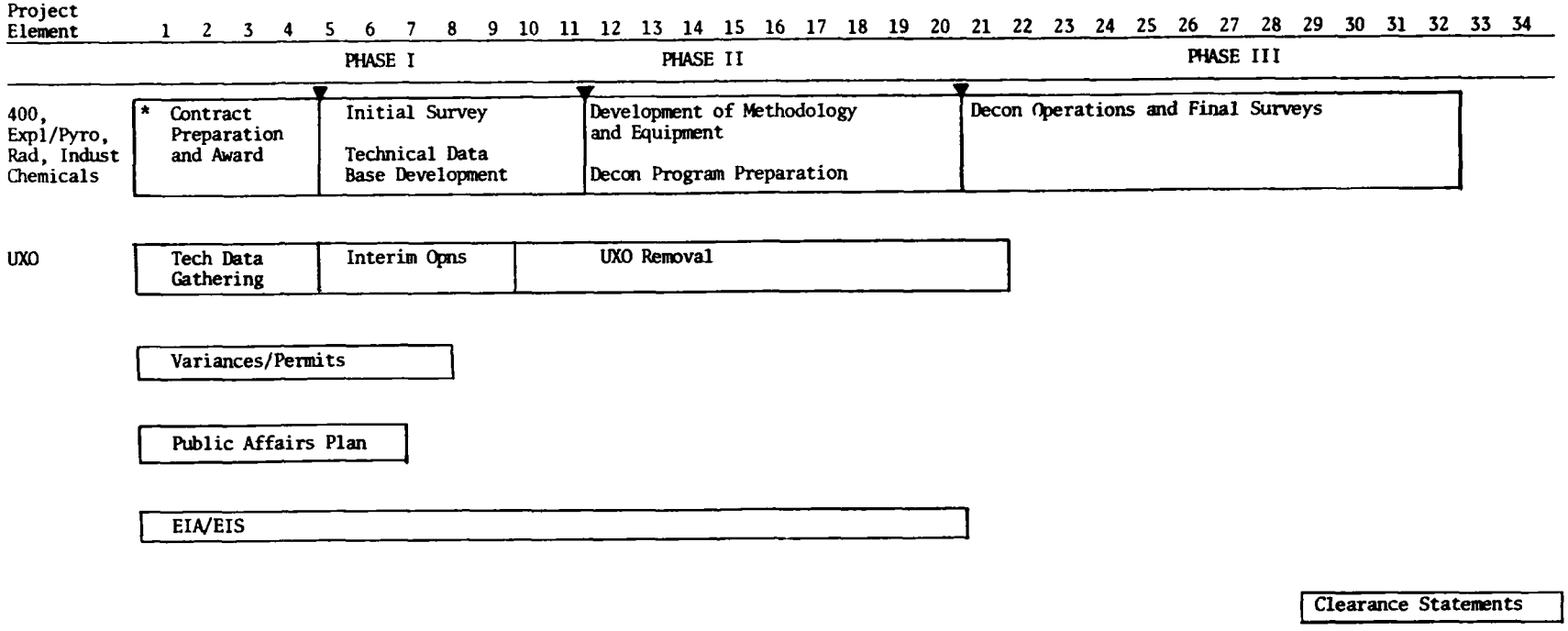
It is also assumed that flashing of explosively contaminated structures and materials will be allowed at least to some extent. Should it be determined that no flashing could be accomplished at FA, this schedule would likely be extended, particularly if transportation of contaminated materials to an off-site location for flashing was similarly not possible.

(3) UXO: Completion of the UXO project element is estimated for 21 months after project approval and funding. However, the start of removal operations will be delayed significantly if either the removal effort must be contracted or the Tech Data Base subelement of the Explosives/Pyrotechnics Project element must be contracted out; and, therefore, this forces a delay in reaching the decision point to go to removal operations. (This is discussed in more detail in Section 4(b)(4).)

Figure 4-1

Frankford Arsenal IR Project Schedule

Months After Project Approval and Funding



*NOTE: Technical Scope of Work being prepared simultaneously with Concept Plan staffing and approval.

▼ Decision Points

Presently, it is planned for the Navy to perform both interim operations and final removal; this is based on very limited discussions, however. It is noted that should delays be encountered in initiating UXO removal, this is not expected to affect overall project completion.

(4) Explosives/Pyrotechnics: This project element represents an area lacking in problem definition; that is, the true extent of the decontamination required is as of yet not known. The magnitude of the decontamination effort will not fully be known until the Building Evaluation task is accomplished. Because FA and ARRADCOM contracts for the packaging, crating, and handling of equipment to be removed from the Arsenal are not expected to be completed until 1979, decontamination could not be completed until calendar year 1980 at any rate.

(5) Radiological: The Radiological project element is projected to be completed 34 months after project approval and funding. Accomplishment of this project element is believed to have significant slack time in all project subelements.

(6) Industrial Chemicals: The Industrial Chemicals project element is projected to be completed 34 months after project approval and funding. Accomplishment of this project element is believed to have significant slack time in all project subelements.

c. Cost.

(1) Financing: Program budget planning and execution (funds) will be accomplished within the OMA (Base Operation .R account, Installation Restoration) and RDTE,A (62764AF25, Military Environmental Criteria Development) appropriations prescribed to support this mission activity, as applicable. These resource program activities are under centralized direction and control of the PM CDIR.

(2) Cost Estimate: The existing PM CDIR OMA program budget submissions do not include the resources for this FA effort. Increased financed program guidance would be required to execute this program as detailed in Figure 4-2. Total program costs are estimated at approximately $5.19 million in FY77 dollars. A breakout of costs by fiscal year is presented in Figure 4-3. A total of $1312K is required in the first fiscal year, $3478 in the second fiscal year, and $400 in the third fiscal year. These costs reflect accomplishment in accordance with the solid bars in Figure 4-1. A funding requirements summary is presented in Figure 4-4. Revised cost estimates will be prepared at the end of Phase I, Technical Data Base Development, as the problems become more defined.

FIGURE 4-2

FRANKFORD ARSENAL IR PROJECT COST ESTIMATE/WORK BREAKDOWN STRUCTURE
(Cost in Thousands)

400 Area		UXO		Explosives/Pyrotechnics		Radiological		Industrial Chemicals		Support Documentation	
Tech Data Gathering		Tech Data Gathering		Tech Data Gathering		Initial Health Physics Survey	50	Industrial Chemicals Survey	30	Procurement Documentation	50
Sump Sampling & Analysis	50	Tech Data Eval	15	Bldg Evaluation	100						
Environ Reqts Definition	20	Available Tech Evaluated	25	Decon Criteria Development	50	Decon Operations	155	Decon Operations	128	Variance/Permits	10
Transport/ Final Disposal Study	20	Interim Opns		Decon Verification Test Method Dev	75	Final Health Physics Survey	30	Final Industrial Chemicals Survey	20	EIS/EIA	60
Decon Method Study	20	Bldg 316 Cross Trench	25	Geotechnical Investigation	125	Contingency for Decon Operations	41	Contingency for Decon Operations	36	Public Affairs Plan	20
Soil Decon Verif. Method	25	Pier 409	50	Decon Program Development	50					Land Use Decision Paper	20
Fitler Sewer Evaluation	25	Frankford Creek	25	Decon Operations	1,500					Land Clearance Statements	40
Geotechnical Investigation	125	Cave	25	Contingency for Decon Operations	360						
Decon Program Development	100	Range	25								
Decon Opns	850	Baird Street Gate	25								
Contingency for Operations	226	UXO Removal	434								
		Contingency for UXO Removal	130								
SUBTOTAL	1,461		779		2,260		276		214		200

TOTAL COST = $5,190

FIGURE 4-3

FUNDING ESTIMATES BY FISCAL YEARS

First FY

400 Area		UXO		Explosives/Pyrotechnics		Radiological		Industrial Chemicals		Support Documentation	
Sump S&A	50	Tech Data Gathering	15	Tech Data Gathering	350	Initial Health	50	Industrial	30	Proc Doc	50
Env Rqmts	20	Av Tech Eval	25	Decon Prog Dev	25	Physics Survey		Chemicals Survey		Variances/Permits	10
Trans/ED	20	Interim Opns	175							EIS	60
Decon Meth	20	UXO Removal	117							Public Affairs Plan	20
Soil Decon Verif.	25										
Fitler Sewer Eval	25										
Geotech Inves	125										
Decon Prog Dev	100										
	385		332		375		50		30		140

TOTAL: 1,312

Second FY

Decon Opns	850	UXO Removal	317	Decon Prog Dev	25	Decon Opns	135	Decon Opns	118	Land Use Decision Paper	20
Contingency	226	Contingency	130	Decon Opns	1,500	Final Health Physics Survey	50	Final Industrial Chemicals Survey	30		
						Contingency	41	Contingency	36		
	1,076		447		1,525		226		184		20

TOTAL: 3,478

Third FY

Explosives/Pyrotechnics		Land Clearance Statements
Congingency	360	40

TOTAL: 400

TOTAL COST: $5,190

FIGURE 4-4

FRANKFORD ARSENAL IR PROJECT
FUNDING REQUIREMENTS SUMMARY - OMA 7 2896.R
($ in Thousands)

Technical Area	First FY	Second FY	Third FY	TOTAL
400 Area	385	1,076	0	1,461
UXO	332	447	0	779
Explosives/Pyrotechnics	375	1,525	360	2,260
Radiological	50	226	0	276
Industrial Chemicals	30	184	0	214
Support Documentation	140	20	40	200
	1,312	3,478	400	5,190

NOTE: The above funding requirements are not within the currently approved IR program guidance.

Based on the 5.19 million dollar cost estimate, the value expected to be obtained by the sale of the property and the care and custody costs which must be encountered if the Arsenal is retained under Department of the Army contract, decontamination is cost-effective. However, a decision point has been included into the project structure to reevaluate this conclusion prior to committing funds for decontamination. At that time a far better cost estimate will be available.

Cost estimates have been based on the following:

--For the UXO project element on the removal of unexploded ordnance only from the six areas where it is currently suspected of being found.

--For the Explosives/Pyrotechnics project element, the decontamination of the approximately 50 buildings presently identified as being contaminated.

--For the Radiological and Industrial Chemicals project elements decontamination costs are based on decontaminating those buildings which are likely to be contaminated.

(3) Work Breakdown Structure: As the technical approach indicates, the conduct of the project is structured into six separate elements: the 400 Area, Unexploded Ordnance, Explosives/Pyrotechnics Contamination, Radiological Contamination, Industrial Chemicals, and Support Documentation. The FA IR project represents level one of the WBS, the six project elements level two of the WBS, the major subelements level three of the WBS, and the tasks which make up the subelements level four.

Figure 4-2 portrays the work breakdown structure. This structure will be used to effectively manage the project. Cost estimates have been developed against this structure and performance and cost reporting will also be based on it.

5. Management Responsibilities.

a. PM CDIR is responsible for:

(1) Department of the Army centralized management, including technical and financial, for the decontamination of the real property at FA.

(2) Preparation of program documentation, to include real property clearance statement and environmental documentation.

(3) Serving as the office of record for the decontamination effort.

(4) Arranging for contractual services, as required.

(5) Supporting ARRCOM in public affairs, legislative, and legal matters, as well as other areas mutually agreed to during conduct of the project.

(6) Establishing a field office located at FA, as required.

(7) Providing ARRCOM with progress reports.

b. ARRCOM is responsible for:

(1) Conducting normal installation administration and logistical support.

(2) Disposal of all non-real property. This includes manufacturing, laboratory and office equipment, and chemicals (laboratory and bulk).

(3) Processing necessary documentation to transfer decontaminated real property to the General Services Administration for disposition.

6. Management Plan.

a. Periodic technical and financial progress reports will be provided by the participating agencies as established by the PM CDIR.

b. Program status review meetings will be scheduled involving all agencies participating and having an interest in this project.

c. Concerned agencies and higher level staffs will be involved in reviewing and approving the recommended future courses of action at the two "Decontamination Decision Points" referred to above.

APPENDIX A

Tasking Documents

DEPARTMENT OF THE ARMY
HEADQUARTERS, US ARMY ARMAMENT MATERIEL READINESS COMMAND
ROCK ISLAND, ILLINOIS 61201

REPLY TO ATTENTION OF:
DRSAR-SF

Mr. Carpenter/mks/793-5843

29 JUN 1977

SUBJECT: Technical Direction of Decontamination at Frankford Arsenal

Project Manager
Chemical Demilitarization and
Installation Restoration
Dover, New Jersey 07801

1. Reference is made to:

a. Charter for DARCOM Project Manager for Chemical Demilitarization and Installation Restoration.

b. Memorandum of Understanding between Project Manager for Chemical Demilitarization and Installation Restoration and US Army Armament Materiel Readiness Command.

c. Letter, DRCPM-DRR, 20 May 77, subject: Visit to Frankford Arsenal.

d. Message, DRSAR-SF, HQ, ARRCOM, 081541Z Jun 77, subject: Decontamination of Frankford Arsenal.

2. Request you assume responsibility for technical direction of the decontamination of Frankford Arsenal and program for the FY 78, OMA funding to cover the project.

3. Acceptance of this technical responsibility will include, but not be limited to, all administrative functions related to development of a scope of work, preparation of a technical data package, input for selection of a contractor and contract award, monitoring of the operation, development of EIA/EIS statements and certification of the decontamination accomplished, to the arsenal commander upon completion.

4. It is recognized that the initial milestones approved by DARCOM for completion of the decontamination project were not achieved; therefore, a new objective schedule is necessary. Recommend that you consider a milestone of awarding a contract NLT Dec 77, and completion of the decontamination project NLT 30 Jun 78.

28 JUN 1977

DRSAR-SF
SUBJECT: Technical Direction of Decontamination at Frankford Arsenal

5. Procurement services associated with the project and other technical assistance that may be required will be provided by ARRCOM.

FOR THE COMMANDER:

WILLIAM T. GREEN
Colonel, GS
Chief of Staff

DEPARTMENT OF THE ARMY
FRANKFORD ARSENAL
PHILADELPHIA, PENNSYLVANIA 19137

REPLY TO ATTENTION OF: SARFA-CO-IS

SUBJECT: Report of Excess for Frankford Arsenal

Commander
US Army Armament Command
ATTN: AMSAR-ISF-R
Rock Island, IL 61201

Submitted herewith in accordance with Milestone Actions V-6 and V-10 of the Implementation Plan for the Closure of Frankford Arsenal dated August 1975, is real property data sufficient to support a Report of Excess for the Frankford Arsenal. Action under V-10 will continue until the completed closure by periodic submissions of additional data as transfers of mission are completed.

9 Incl
1. Report of Excess (6 cys)
2. Environ. Impact Statement (6 cys)
3. Bldg Data (6 cys)
4. Historical Bldgs (6 cys)
5. Family Housing (6 cys)
6. Misc Structures (6 cys)
7. Installed Bldg Equip (6 cys)
8. Utilities (6 cys)
9. F. A. Map, FT-12953 (12 cys)

CF:
District Engineer, Baltimore District
Corps of Engineers, P.O. Box 1715
ATTN: NABRE-M, Baltimore, MD 21203

SMCAR-TSP-P (16 Jun 87) 1st Ind [illegible]

SUBJECT: Report of Excess for Frankford Arsenal

HQ, US Army Armament Command, Rock Island, IL 61201 4 AUG 1987

TO: Commander, USA Mat Dev & Readiness Comd, ATTN: DRCIS-RR

1. Report of Excess for Frankford Arsenal, Philadelphia, PA, is forwarded in accordance with AR 405-90.

2. Information required for preparation of a Title 10 Disposal Report is attached as Inclosures 1 through 9. Decontamination plans are currently being prepared and will be provided upon receipt.

FOR THE COMMANDER:

9 Incl
wi 1 cy ea

PATRICK J. GOFF
Acting Dir, Installation Svc Dir

DAMI-FR (16 Jan 76) 2nd Ind
SUBJECT: Report of Excess for Frankford Arsenal

Headquarters, US Army Materiel Development and Readiness Command, 5001 Eisenhower Avenue, Alexandria, VA 22333

TO: HQDA (DAMI-MSZ-R) WASH DC 20314

30 Aug 76

1. Forwarded in accordance with AR 405-90 is a Report of Excess for the Frankford Arsenal, Philadelphia, PA.

2. The Tacony Warehouse portion of Frankford Arsenal was re-assigned to Ft. Dix accountability on 24 June 1976 and is, therefore, not included as part of this Report.

3. A meeting was held at Frankford Arsenal 13-14 August 1975 with the Pennsylvania Historical and Museum Commission and the Philadelphia Historical Commission to review properties which are of historical significance. Tentative conclusions were that the area marked on the attached plot plan containing 9.6 acres should be preserved as a historical site. Other related facilities may be identified by the Commissions as having historical significance at a later date. The Commissions found no installed or related personal property as having historical value.

4. The decontamination plans mentioned in the preceding 1st Ind are being prepared and will be furnished after receipt and review by this Command.

5. Recommend this Report of Excess be approved.

FOR THE COMMANDER:

Incl
nc
wd 1 cy

/s/
HARRY P. SCHILLING
Colonel, CE
Chief, Engineer Division
Directorate for Installations
and Services

COORDINATION & CER ON ATTACHED PAGE.

DRCIS-ER
SUBJECT: Report of Excess for Frankford Arsenal

FYR: Mr. Voss/49003/djp/T: 20 Aug 76

COORDINATION: DRCPA

DRCPP

DRCCP

DRCPT

DRCIS-S

CF: CDR,AMCOM, ATTN: DRSAR-ISF-R

APPENDIX B

Criteria Documents (Selected)

DDESB (10 May 1977)

TO DAEN-REM-C
ATTN: Mr. Bannister
Forrestal Bldg

FROM DDESB
Forrestal Bldg

DATE 20 Jun 77
P.G. Kelley/mes/35443

CMT 7

In accordance with your request the draft Section 13 has been reviewed and the following comments are submitted.

a. Recommend Inclosure be used as introductory material in the proposed pamphlet. The proposed pamphlet is an ideal vehicle for disseminating and reinforcing existing DOD policy on the release of contaminated real property. The users of the pamphlet will be the individuals with decision making responsibility on excess real property actions.

b. Recommend so much of Paragraph 13-3 that relates to the Explosives Safety Board be changed to read as follows: "....DOD Explosives Safety Board has responsibility for reviewing and approving from an explosive safety viewpoint clearance reports for real property declared excess and offered for disposal. The Board may be consulted for assistance in the review and analysis of clearance work performed to determine its adequacy."

c. Considering the scope of material covered, a more appropriate title for the pamphlet would be: "Control and Disposition of Contaminated Land."

d. A restructuring of the pamphlet generally in accordance with the outline format at Inclosure 4 would make it easier to use.

P. G. KELLEY, JR.
Colonel, USA
Chairman

Incls
Added 2 incl
3. Section 13
4. Pamphlet Outline

CF: Mr. Roche, DASD(I&H)-IR

SECTION 13

Control and Disposition of Contaminated Land

13-1. Policy

a. The current DoD policy with regard to the release of contaminated land is that real property which is known to be contaminated with hazardous materials which could endanger the general public should not be released until the most stringent efforts have been made to assure appropriate protection to the public.

b. A GSA policy statement (Sec 101-47.401-1 (c)) and decontamination requirements of Federal Property Management Regulations stipulate that excess and surplus real property which is dangerous to public health and safety be destroyed or rendered innocuous by the holding agency in order to protect the general public from hazards and to preclude the Government from any and all liability resulting from indiscriminate disposal or mishandling of contaminated property.

c. This policy applies to all real property which has been contaminated through its use as manufacturing areas; firing and impact ranges; and waste collection or disposal sites, including pads, pits, basins, ponds, streams and burial sites as well as other uses incident to ammunition or explosives.

d. Property designated as buffer zones for ammunition and explosives functi is considered fully utilized and will not be declared excess. Limited private use of buffer zones (e.g., cattle grazing) may be authorized by the Services if such use will not contravene safety considerations for either personnel or property.

13-2. General

a. There is a common misconception as to the adequacy of decontamination procedures for range impact areas. Experience has shown that not all unexploded ordnance can be detected or removed during either a surface or subsurface clearance effort.

Unfortunately, the general impression (both military and civilian) is all too often that a contamination certification means total removal of all explosives items. Even with current technology and devices for both surface and subsurface detection, some items of unexploded ordnance may escape detection and removal. Further, many buried and undetected explosive items may be subsequently surfaced due to soil erosion, climatic, and geological conditions, thereby posing a potential explosive hazard.

b. The Army has been designated the lead Service for the compilation and refinement of applicable technology and for the development of new and improved technology and criteria or standards for clearing contaminated real property.

Pamphlet Outline

I. Policy (Incl 3)

II. General Information (Incl 3)

III. Responsibilities

Air Force (Sec 13-1)

Army (Sec 13-2b, 13-3 (COE))

IV. Clearance Standards

Industrial Property (Sec 13-4)

Artillery and Other Ranges (Sec 13-6, 13-7, 13-8)

Cost Considerations (Sec 13-5)

V. Reporting of Contaminated Land

General (Sec 13-9)

Statement of Clearance (Sec 13-10, 13-11)

Recording Statement of Clearance (Sec 13-12)

VI. Disposition of Contaminated Land

Sec 13-13, Sec 13-14, Sec 13-15, Sec 13-19, Sec 13-20

VII. Control of Contamination and Contaminated Land

Sec 13-16, Sec 13-17, Sec 13-18

SECTION 13

CLEARANCE OF EXPLOSIVE HAZARDS AND OTHER CONTAMINATION

13-1. Clearance of Air Force Lands. As stated in AR 405-90, the Chief of Engineers has no responsibility for inspecting or clearing excess Air Force land of explosives or chemical/biological contaminants. When a target or bombing range, or other land under the control of the Department of the Air Force, which might be contaminated with explosives or other harmful or dangerous substances, becomes excess to Defense requirements, the appropriate DE will obtain a certificate as to the extent of contamination and clearance thereof from the Air Force Logistics Command, Wright-Patterson Air Force Base, Ohio 45433. The Corps of Engineers will continue to be the agency with which the disposal agencies, purchasers and former lessors will communicate when explosives, or objects resembling explosives, are discovered on the land after disposition has been effected. The AF Logistics Command, upon request of the DE will neutralize or remove such objects or substances and make a report to the requesting agency or person. See paragraph 13-20 below for support required of the Corps.

13-2. Clearance of Army Lands. As set forth in AR 405-90, the responsibility for performing clearance of contaminated excess Army real property is placed upon and remains with the using command. The using command, after completion of the clearance work, will furnish the DE a "Statement of Clearance" and a record of the clearance work performed.

13-3. Responsibilities of the Chief of Engineers. The DE, as designee of the Chief of Engineers, will satisfy himself that the clearance work, as certified in the "Statement of Clearance" has been performed and that such clearance complies with the requirements of this chapter. If the

DE determines that the completed clearance work is not sufficient, he will request the using command to perform the necessary additional clearance. The Department of Defense Explosives Safety Board, established by DOD Directive No. 5154.4, 23 October 1971, may be consulted for review and analysis of accomplished clearance work when determinations of sufficiency are not within the capacities of the DE. Requests, fully documented, for review and/or analysis by the "Board" may be forwarded to HQDA (DAEN-REZ-R), WASH DC 20314, for submission to the "Board." Department of Defense procedures require staff study of all proposed excess reports by the "Board" before grant of "Prior Approval" for those disposals requiring reports to the Armed Services Committees, P.L. 89-568 (Sec. 613, 80 Stat. 757, 10 U.S.C. 2662). When the clearance work has been satisfactorily performed, disposal action will be continued as set forth in other paragraphs of this chapter. If the DE determines that further clearance work is necessary to render the land safe for use but that such further clearance work is not economically justified, he will make a report to the Chief of Engineers, HQDA (DAEN-REZ-R), WASH DC 20314, with his recommendations and pertinent supporting data. The report will include a statement of the current status of the excess action.

13-4. Contaminated Industrial Property. Ordinarily no decontamination will be performed by the Department of the Army on contaminated excess industrial Army installations. Instead, they are reportable in their contaminated state to GSA for disposal pursuant to agreement reached with that agency. If a determination of excess, which indicates that decontamination work is proposed by the Army, is received by the DE, the using command will be promptly advised not to perform such work. Reports

of excess to GSA covering such properties will include statements, as outlined in Appendix E, AR 405-90, containing but not limited to:

a. The extent and type of contamination;

b. Comments on possible decontamination measures, if any, and;

c. The extent to which the property may be used without future decontamination.

After the plants are determined to be surplus, GSA will advertise them for disposal with the condition that the purchaser will accomplish any necessary decontamination. Decontamination will be accomplished under the supervision of an Army decontamination expert detailed for that purpose by the using command, on a reimbursable basis. As indicated in AR 405-90, if GSA cannot dispose of the property in its contaminated condition, it may be withdrawn from excess and returned to the using command for care and custody.

13-5. Limitations on Clearance Cost. The following principles are established for determination of the financial limit of clearance operations at excess installations:

a. Government-owned land. Clearance work will not be undertaken where the estimated cost thereof exceeds the value of the land after decontamination plus the estimated cost of keeping it security-fenced and posted for a period of 25 years.

b. Leased land. Clearance will not be undertaken where the estimated cost, plus the cost of any other required land restoration work, exceeds the value of the land after clearance and restoration plus the estimated cost of keeping it security-fenced and posted for a period of 25 years.

13-6. Clearance of Practice Bombs. Dedudding of ranges on which only practice bombs have been dropped and which comprise only grazing lands, or other lands not suitable for cultivation or other subsurface operation will be limited to those duds which are on or exposed to the surface of the ground. On lands suitable for cultivation or other subsurface operation, all duds which can be detected by visual search, probing, and use of metal detectors will be destroyed and scrap metal removed. This is considered adequate to render such ranges reasonably safe for civilian use.

13-7. Clearance of Military Scrap. Military scrap is defined as whole missiles, or sufficiently large portions to resemble missiles, and which could possibly contain explosives and/or chemical/biological agents. The primary consideration in determining whether scrap metal will be removed should be the safety of persons coming on the land in question and, secondarily, the prevention of accidents resulting from the sale and/or use of the scrap metal subsequent to the land passing from the jurisdiction of the Department. DE's will insure the removal or destruction, by the using command, of all military scrap and scrap metal from lands suitable for cultivation or other subsurface operations. In the case of land unsuitable for cultivation or other subsurface operations, all military scrap will be removed or destroyed and scrap metal removed, if it is reasonably possible to do so. Cases where it is considered impractical to remove the scrap metal, will be reported to the COE for final decision. In such instances, pertinent data and the DE's recommendations will be furnished. Disposition of military scrap or scrap metal by dumping into inland waters or by land burial is prohibited.

13-8. Restricting Future Use of Artillery and Other Ranges. Experience indicates that, on ranges where high explosive projectiles have been fired or dropped, such as artillery, bombs, mortars, rockets, grenades, etc., it is impossible to make certain that land in impact areas is absolutely safe for unrestricted use. Such impact areas receive a high concentration of fire, and the properties of these projectiles are such that many duds are deeply buried. In addition, because of the concentration of fragments in the earth in such impact areas, the mine detector cannot be relied upon, with certainty, to detect all duds. Since there is no known definite period within which such projectiles will become inert through weathering and corrosion, such contaminated areas can be safely released for restricted use only, even after dedudding work has been carried to its practicable limit. Such restrictions will usually be in the form of a recommendation that the land be restricted to surface use only. Restrictions will be based solely on the type and/or extent of contamination. If land is contaminated to such a degree that it is considered that it cannot be rendered safe for any use, disposal action will be suspended and the facts will be reported to DAEN-REZ-R with the DE's recommendations.

13-9. Reporting Contaminated Land to the General Services Administration. Contaminated areas, except industrial properties as covered by paragraph 13-4 above, will not be included in a Report of Excess to GSA until such time as the affected areas have been cleared by the using command to the satisfaction of the DE and a "Statement of Clearance" has been received. If an exception is granted and the Department of the Army, with the concurrence of GSA, reports contaminated non-industrial property excess, the report of excess will include statements concerning:

a. The extent and type of such contamination;

b. Plans for decontamination, if any, and;

c. The extent to which the property may be excessed without future decontamination.

13-10. Statement of Clearance in Reporting Excess Property to GSA. The Report of Excess will include the "Statement of Clearance" furnished by the using command pursuant to AR 405-90. The record of the clearance work performed by the using command will not be included in the Report of Excess but will be preserved in the permanent records of the DE. It is anticipated in these cases that the disposal agency (GSA) will, at the time the land is offered for sale or lease, give public notice of the circumstances surrounding its past and future restricted use. Included in such notice will be the statement that the Department of the Army is willing to remove or destroy any potentially dangerous materials discovered at any time in the future, subject to the availability of funds for this purpose.

13-11. Reporting Artillery and Other Ranges. All Reports of Excess to GSA covering lands which have been used as target ranges of any kind will contain an affirmative or negative statement in regard to contamination. This will be by appropriate schedule and reference thereto in the following manner:

a. If the statement is negative, it will declare that no explosive or other contaminating materials were used or stored on any portion of the installation.

b. If the statement is affirmative, reference will be made to appropriate schedules of the Report of Excess containing statements of clearance on the installation, or portions thereof.

13-12. Recording Statements of Clearance. On property disposals for which the Corps of Engineers is the disposal agency, the DE will have the statement of clearance recorded, if possible, as part of the permanent history of the property involved, with the proper county land record office. A copy of the report of clearance work performed, will be furnished DAEN-REM and DAEN-REP.

13-13. Return of Contaminated Leased Land to Owners. In the case of recommended restriction of use, notice should be given the lessor as described in paragraph 13-10 above.

a. Where such a restriction reduces the value of the land, the Department will, if consistent with the terms of the lease, pay damages equal to the reduction in value as of the effective date of termination.

b. As stated in paragraph 13-10, the owner should be advised that the Department is willing to remove or destroy any potentially dangerous materials that may be discovered in the future, subject to the availability of funds.

13-14. Supplemental Agreement with Owner of Contaminated Leased Land. In the event that is becomes necessary to pay damages to a lessor in lieu of restoration (i.e., complete decontamination), the following clauses, appropriately modified to fit the circumstances, will be made a part of the supplemental agreement terminating the lease and effecting monetary settlement in lieu of restoration. Additionally, in order to

protect the Government from possible claims for damages from future purchasers, the executed supplemental agreement will, in those jurisdictions permitting recordation, be recorded by the DE thus providing legal notice to subsequent purchasers of the condition of the premises.

Format of Supplemental Agreement

WHEREAS, by reason of the use made of the premises by the Government it is impossible to ascertain after completion of decontamination operations by the Government that the following described portion of land is absolutely safe for unrestricted use by the lessor (or state because of use made by Government that use of land must be restricted to grazing, etc.):

(Legal Description); utilize hachured/annotated map/s as attachment plus legal description))

Now, therefore, in consideration of the payment by the Government of the United States to the lessor (Name of lessor) of _____ dollars ($_____), representing the estimated compensation to which the lessor is entitled by reason of the loss of the unrestricted use of the above described property, the lessor hereby releases the Government from all claims for damages to property and/or injury to persons which may arise out of the existence on the premises of unexploded annumition or chemical/biological agents. It is mutually understood, however, that for a period of 25 years from the date hereof, the Government shall, upon request of the lessor, remove or destroy any potentially dangerous materials that may be discovered on the land, provided that adequate appropriations are available to cover the cost of such service.

(If use of the land is restricted to surface use, the lessor should agree and covenant, in consideration of the payment, to use the land for such purposes only.)

13-15. Conditions in Conveying Land Suspected of Contamination. The following conditions, appropriately modified to conform to local law, will be included in deeds conveying land which is, or is suspected of being, contaminated with explosive or toxic objects or materials and is restricted to surface use:

"WHEREAS, said property was a part of (Name of Installation), a military installation used for ---------, and portions of this property were subject to contamination by the introduction into the said installation of dangerous bombs, shells and other charges (insert reference to toxic chemicals/biological agents, if applicable) either below or upon the surface thereof; and

"WHEREAS, the grantor has caused the property to be inspected and has decontaminated the said property to the extent deemed reasonably necessary, and, to the extent deemed consistent with sound economic limitations, has cleared the property of all dangerous and explosive materials, and/or chemical/biological agents, reasonably possible to detect, and has made certain recommendations pertaining to the use to which the land may be devoted, and the said recommendations are contained in a statement, a copy of which is attached hereto and made a part hereof; and

"WHEREAS, the grantor, by attaching such statement, does not intend to make, nor shall it be construed to have made, any representations or warranties pertaining to the condition of the land; and

"WHEREAS, the hereinafter-designated grantee has entered into a contract to purchase said property with full knowledge of, and notwithstand.. the foregoing recitals which are incorporated for the purpose of disclosing the former use made of the property hereinafter described; and

"WHEREAS, by acceptance of this instrument, the grantee admits and confesses to full knowledge with respect to the facts contained in the foregoing recitals as to possible contaminated condition of the property;

"NOW, therefore, by acceptance of this instrument, and as a further consideration for this conveyance, the grantee here covenants and agrees for himself, his heirs, successors, or assignes, to assume all risk for all personal injuries and property damages arising out of ownership, maintenance, use and occupation of the foregoing property; and further covenants and agrees to indemnify and save harmless the United States of America, its servants, agents, officers, and employees, against any and all liability, claims, causes of action, or suits, due to, arising out of, or resulting from, immediately or remotely, the possible contaminated condition, ownership, use, occupation or presence of the grantee, or any other person, upon the property, lawfully or otherwise."

13-16. Warning to Public of Danger in Handling Explosive Missiles. When any land which has been contaminated with explosvie objects, or chemical/biological agents, is released for disposal to, or use by, the general public in addition to the clearance statement furnished to the disposal agency, the DE will publicize, to the fullest extent practicable, the possibility of contaminants remaining on the land and the inherent danger of handling explosives or other contaminants. Such publication should be in the form of articles in official news media, or posting of

the premises whenever the latter is considered most feasible. Such publicity should include instructions that, in the event of the discovery of an explosive missile, or an object resembling an explosive missile, or other contaminant, or in the event of an injury caused by an explosion, or exposure to toxic agents, such discovery or injury should be reported immediately to the DE. An effort should be made to obtain the cooperation of local law enforcing agencies to insure the prompt reporting of an accident, or the discovery of an explosive missile. The majority of accidents are the result of the removal of explosive missiles by individuals for sale to scrap dealers. Scrap dealers in the vicinity of contaminated lands should be informed of the inherent dangers and asked to cooperate by refusing to buy military scrap from private parties.

13-17. Reporting Accidents. Immediately upon receipt of information of an accident involving, or appearing to involve, explosive or chemical/biolo[illegible] elements remaining on, or carried from an excess or surplus installation, whether under the jurisdiction of the Corps of Engineers, other Government agency, or sold or returned to public or private owners, the DE will institute an investigation and prepare a report prescribed by AR 385-40 and OCE Supplement thereto. Further, upon determination that an accident has occurred, the [illegible] should be requested to send qualified explosive, chemical or biological specialists to the scene of the accident immediately, in order that proper corrective measures to eliminate future accidents may be instituted. The Office of the Chief of Engineers, DAEN-REM, will be immediately informed, by teletype, of any accidents due to explosives on lands which have been used by the Department involving injuries to persons and/or animals, or damages to private property.

13-18. Contamination Discovered After Return of Land to Owner or Sale. When land has been previously declared clear of explosives or other dangerous material so as to be safe for all uses and disposed of, but is later found to have been contaminated to such an extent that, in the opinion of the DE, it is dangerous to the public, he will request the former using command to reexamine the land for the purpose of determining the extent to which the original statement of clearance should be revised and to determine the kind and cost of any further clearance work by the using command which would be required to place the property in the condition set forth in the original statement of clearance. If further clearance work is necessary and considered economically justified, the DE will request the using command to perform such work and furnish a new statement of clearance and record of the further clearance effected. If further clearance work is not considered economically jusitifed, he will make a report thereon to the COE, DAEN-REM, with his recommendations and pertinent supporting data. Recommendation for reacquisition of contaminated lands will be limited to those which involve full restriction of both surface and subsurface uses. Where subsurface use of lands only is to be restricted, it is preferable to make compensation to the owners through claim procedure, when and if instituted by the owner on his own initiative.

13-19. Return of Public Domain Land.

a. General. The procedures described elsewhere in this chapter to carry out the continuing responsibility of the Department of the Army to assist and advise the land holder and protect the public from dangerous substances on or in the land after release are equally applicable to public domain lands. Air Force policy and procedure are generally comparable.

b. Congressional. Several laws enacted by the Congress to withdraw public domain, as required by the Engle Act, P.L. 85-337, 43 U.S.C., Sections 155-158 (10 U.S.C., Section 2671 and 40 U.S.C., Section 472(d)), contain the following quoted provision applicable to withdrawals for both the Air Force and Army:

"Upon request of the Secretary of the Interior at the time of final termination of the reservation effected by this Act, the Department of the Army shall make safe for nonmilitary uses the land withdrawn and reserved, or such portions thereof as may be specified by the Secretary of the Interior, by neutralizing unexploded ammunition, bombs, artillery projectiles, or other explosive objects and chemical agents."

The intent of this provision is explained by a statement of the Committee on Interior and Insular Affairs, House of Representatives, in Report No. 279, 87th Congress, 1st Session: "*** the committee concluded that it would be appropriate to amend the bill to designate the Secretary of the Interior to act on behalf of the Federal Government in delineating the areas to be made safe for nonmilitary use when the lands are no longer required for defense purposes. It is expected that the Secretary of the Interior will not require the Department of the Army to proceed with expensive cleanup work in areas where there would be no direct benefit. On the other hand, it is anticipated that when potential resources or use values are such as to make dedudding or decontamination advisable, the Secretary of the Interior will identify those resources and values for the Secretary of the Army. This will permit a full and complete justification in the event that a separate appropriation therefor is required." Report No. 279 also quoted the following statement by the

Bureau of the Budget: "*** requirement for decontamination should be related to a standard not only of practicability, but also to one of economic feasibility that takes into account the desired future use and value of the land to be decontaminated." This intent is borne out further by the fact that Public Law 87-327, withdrawing land at Fort Richardson, Alaska, did not contain the above provision for clearance, at the request of the Secretary of the Interior. In the hearings on P.L. 87-327, it was brought out that the land being withdrawn was already dangerously contaminated and that clearance was impracticable.

c. Army. The COE does not consider that the Congressional policy, as outlined above, changes the existing Army policy. Its principal effect is to make it clear that the Secretary of the Interior has an equal interest with the Secretary of the Army in the final decision on whether it is practicable or feasible to clear lands for return to the public domain, and the extent of clearance. No difficulties in reaching agreement with Interior in these matters are anticipated. Where large expenditures are involved, it will usually be necessary to request a special appropriation, leaving the final decision to Congress. In any instance, if difficulty in reaching agreement with officials of the Bureau of Land Management (or Secretary of the Interior) should occur, it will be reported promptly to the Chief of Engineers, DAEN-REM, with complete background data for review and instructions.

13-20. Support in Clearance of Air Force Lands. Where Air Force range lands are proposed for disposal, the AF Logistics Command, in most cases, will make an economic study to determine the extent of clearance that is justified by the relative values of the property before and

after decontamination. For this purpose, AF commands declaring range lands excess will submit a copy of the excess recommendation to the AF Logistics Command. Upon request, DE's will prepare and furnish a disposal planning report to the AF Logistics Command for assistance in making the economic study. The disposal planning report will include, but need not be limited to, the following:

a. A map which depicts and annotates differing areas according to their estimated highest and best use.

b. An appraisal report reflecting the fair market value of each of the differing areas based on their highest and best use, and based on the assumption that the lands are entirely free of dangerous materials or other contamination.

AF Logistics Command will compare such evaluation with cost of decontamination work. While needed primarily in connection with the return of AF range lands to the public domain, economic studies may be made and disposal planning reports requested by the AF in other areas.

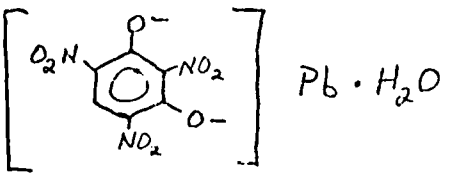
APPENDIX C

Technical Data

NAME: Lead Styphnate

SYNONYM: Lead Trinitroresorcinate

FORMULA: $PbC_6HN_3O_8 \cdot H_2O$



PHYSICAL STATE: Orange-yellow to reddish brown crystals

MELTING POINT: Explodes 260-310°C

SENSITIVITY: Very sensitive; detonated by heat, shock, friction, and electrstatic discharge

HAZARD CLASS: 1.1 (AMCR 385-100)

DENSITY: 1.4-1.6; 3.02 (compressed)

SOLUBILITY: 0.04% in water; less soluble in acetone and alchol; insoluble in ether, chloroform, carbon tetrachloride, carbon disulfide, benzene, toluene, conc hydrochloric acid and glacial acetic acid; somewhat soluble in 10% aqueous ammonium actate solution

CHEMICAL ACTIVITY: Decomposed by conc nitric or sulfuric acids; when dissolved in ammonium actate solution, reacts with potassium dichromate to give potassium styphnate and insoluble lead chromate

USES: Priming compositions

COMMENTS: By itself, has low initiating efficiency

Name: Sodium Styphnate

Synonym: Sodium Trinitroresorcinate

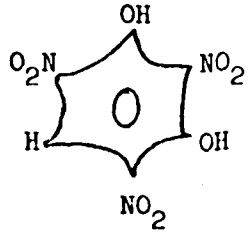
Formula: $Na_2C_6HN_3O_8$

Comments: Expected to be as explosive as lead styphnate; obtained by treating lead styphnate with sodium hydroxide.

Name: Styphnic Acid

Synonym: Trinitroresorcinol

Formula: $C_6H_3N_3O_8$



Physical State: Hexagonal crystals or white powder

Melting Point: 179-80°C

Boiling Point: sublimes

Sensitivity: Explodes on heating rapidly

Hazard Class:

Density:

Solubility: 0.68% in water at 25°C; 1.14% in water at 62°C; soluble in alcohol and ether

Chemical Activity: Strongly acidic

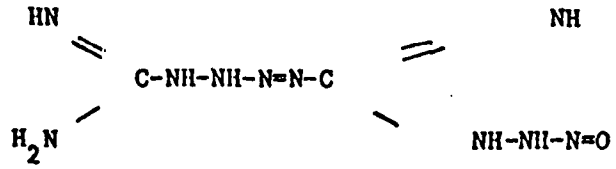
Uses: Manufacture of lead styphnate

Comments: Similar to picric acid in explosive power

NAME: Tetracene

SYNONYM: Tetracine; tetrazene; 4-guanyl-1 - (nitrosoaminoguanyl) - 1 - tetrazen

FORMULA: $C_2H_8N_{10}O$



PHYSICAL STATE: Colorless to pale yellow crystals

MELTING POINT: Explodes 140-160°C

SENSITIVITY: Very sensitive; detonated by heat, shock, and electrostatic discharge

HAZARD CLASS: 1.1 (AMCR 385-100)

DENSITY: 0.45; 1.05 at 3000 psi

SOLUBILITY: Practically insoluble in water, alchol, acetone, ether, benzene, carbon tetrachloride and ethylene dichloride; soluble in conc hydrochloric acid

CHEMICAL ACTIVITY: Decomposed by boiling water with liberation of nitrogen gas; basic hydrolysis yeilds ammonia, cyanamide, and triazonitroso-aminoguanidine; reacts with excess silver nitr to form the double salt $AgC_2H_7NO_{10}O \cdot AgNO_3 \cdot 3H_2O$; forms explosive salts with perchlorate

USES: Priming compositions

COMMENTS: By itself, has low initiating efficiency; experiences 23% weight loss in 48 hours at 100°C

Name: PETN

Synonym: Pentacrythrite tetranitrate; penta; pentrit; nitro pentaerythrite

Formula: $C_5H_8N_4O_{12}$

$C(CH_2ONO_2)_4$

Physical State: White prismatic needles

Melting Point: 141.3°C

Boiling Point: Explodes at 210°C

Sensitivity: One of most sensitive of noninitiating class; more sensitive to impact than RDX or tetryl; more sensitive to friction than nitroglycerin; sensitive to electrostatic discharge; with 35% water present, can still be detonated by No.6 electric blasting cap

Hazard Class:

Density: 1.77

Solubility: 0.004% @ 25°C; 0.018% @ 96°C; slightly soluble in methanol, ethanol, ether, benzene, toluene, carbon tetrachloride and cyclohexanol; soluble in acetone and methyl acetate.

Chemical Activity: Decomposed slowly by boiling 2.5% aqueous caustic; decomposed slowly by sodium sulfide solution at 50°C; decomposed rapidly by boiling ferrous chloride solution; with moisture, corrodes brass, cadmium, zinc, copper, and nickel.

Uses: Detonating fuse and boosters; priming compositions.

Comments: More sensitive when mixed with gritty material; one of the most brisant of the military high explosives; small doses cause decrease in blood pressure; large doses cause dyspnea and convulsions.

Name:	Strontium Oxalate
Formula:	SrC_2O_4-H_2O
Physical State:	White crystalline powder
Melting Point:	Loses water at 150°C
Solubility:	0.0051 grams/100 cc H_2O at 18°C; 5 grams/ 100 cc H_2O at 100°C; soluble in nitric and hydrochloric acids
Chemical Activity:	Burns with red color; corrosive
Uses:	Pyrotechnic compositions (colored stars)
Comments:	Oxalates have a caustic effect when moist; toxic fumes are emitted when heated to decomposition

Name:	Strontium Peroxide
Synonym:	Strontium Dioxide
Formula:	SrO_2
Physical State:	White powder
Specific Gravity:	4.56
Melting Point:	Decomposes at 215°C
Solubility:	0.018 grams/100 cc H_2O at 20°C
Chemical Activity:	Oxidant; decomposes gradually in presence of air
Uses:	Traces powders; pyrotechnics

Name: Strontium Nitrate

Formula: $Sr(NO_3)_2$

Physical State: White granules or powder

Specific gravity: 2.986

Melting point: 570°C

Solubility: 70.9 grams/100 cc H_2O

Chemical Activity: Oxidant; burns with red color; burns brilliant white when mixed with barium nitrate and an oxidizable material.

Uses: Used in tracer powders; red flares; when mixed with barium nitrate, used for aviation signals and illumination flares; used in marine signals, matches, and railway flares.

Name:	Red Phosphorus
Formula:	P_4
Physical State:	Reddish-brown cubic or amorphous powder
Specific Gravity:	2.38
Melting Point:	Ignites at 200-280°C
Solubility:	Very slightly soluble to insoluble in water, carbon disulfide, and conc sulfuric acid; soluble in absolute alcohol
Chemical Activity:	Mixtures of P and potassium chlorate explode from shock and fire; less reactive than WP; forms phosphorus pentoxide easily
Uses:	Detonating compositions with potassium chlorate; pyrotechnics; mixed with arsenious oxide and paraffin for smoke boxes in smokeless HE munitions

Name:	Potassium Perchlorate
Synonym:	Potassium hyperchlorate
Formula:	$KClO_4$
Physical State:	Colorless crystals or white crystalline powder
Specific Gravity:	2.52
Melting Point:	Decomposes at $400^{\circ}C$
Solubility:	0.75 grams/100 cc H_2O at $0^{\circ}C$; 21.8 grams/100 cc H_2O at $100^{\circ}C$; very slightly soluble in alcohol; insoluble in ether
Chemical Activity:	Decomposed by concussion in the presence of oxidizable material including organic matter; oxidant
Uses:	Primer compositions; chlorate explosives; permissible explosives; oxidant in aluminum and magnesium flares, smokes, stars, and railway torpedoes; used to produce loud report when combined with sulfur or antimony sulfide

Name:	Lead Dioxide
Synonym:	Lead Peroxide; Plattnerite
Formula	PbO_2
Physical State:	Brown powder
Specific Gravity:	9.375
Melting Point:	Decomposes at 290°C
Solubility:	Insoluble in water and alcohol; soluble in dilute hydrochloric acid; slightly soluble in acetic acid
Chemical Activity:	Powerful oxidant; evolves oxygen on heating
Uses:	Oxidant in detonating compositions

Name:	Zirconium
Formula:	Zr
Physical State:	Hard, lustrous, silver gray crystalline scales
Specific Gravity:	6.49
Melting Point:	1852°C; auto-ignition in air at 260°C
Boiling Point:	3578°C
Solubility:	Insoluble in water; slightly soluble in acid; soluble in hydrofluoric acid and aqua regia
Chemical Activity:	Corrosion resistant; burns in air at high temperatures reacting more rapidly with nitrogen than oxygen; reducing agent; easily oxidized as a dust.
Uses:	In finely divided form, used in priming mixtures; fuze heads in combination with lead styphnate
Comments:	Toxic; recommended TLV of 5 mg/m^3

TABLE 4-1
RADIOACTIVE CONTAMINATION GUIDES

Contaminated Items and Indications for Actions	Fixed or Removable	Contamination Level: Alpha dpm per 100 cm2	Alpha dpm per 100 cm2	Beta-gamma 1/ mrad/hr @ 1 In.	Beta-gamma 1/ dpm per 100 cm2*	Method of Measurement
1. Clothing, including shoes:						
a. Personal. Should be replaced, decontaminated or stored for decay if above:	F	200		.05*		Probe
	R		More		None	Smear 3/*
b. Anticontamination. 2/						
(1) General. Should be replaced and/or decontaminated if above:	F	1000		0.2 *		Probe
	R		200		1000	Smear 3/*
(2) Respirators. Should be decontaminated after use if above, or replaced:	F	200		1.0 4/*		Probe
	R		None		None	Smear 3/*
2. Containers. Prior to nonradioactive use, should be decontaminated if above:	F	200		0.2 *		Probe
	R		None		100	Smear 3/*
3. Work Areas and Equipment. 5/ 6/						
a. Uncontrolled. Requires decontamination if above:	F	1000*		0.2 *		Probe
	R		100*		100*	Smear 3/*
b. Controlled:						
(1) Areas:	F	1000*		.05*		Probe
	R		200*		400*	Smear 3/*
(2) Hoods:	F	1000		2.0		Probe
	R		200		2000	Smear 3/*
(3) Glove Boxes:	F	5000		2.5		Probe
	R		1000		5000	Smear 3/*
(4) Workbench Surfaces:	F	1000		0.5		Probe
	R		200		400	Smear 3/*
(5) Other Equipment Items:	F	1000*		2.00*		Probe
	R		200*		2000*	Smear 3/*
4. Skin:						
a. Body. Continue decontamination if above:	F	200		0.06		Probe
	R		None		None	Smear 3/*
b. Hands. Continue decontamination if above:	F	400		0.06*		Probe
	R		None		More	Smear 3/*

1/ Measured through not more than 7 milligrams per square centimeter of total absorber and averaged not more than 1 square meter. *
F Fixed
R Removable
2/ Contaminated clothing should be released to a licensed laundry only.
3/ Smears analyzed with a calibrated counting system. *
4/ In contact with any surface of the mask. *
5/ For natural, depleted, and ^{238}U levels for alpha contamination should be increased by factor of 5. (In accordance with AEC guidelines.) *

Depleted Uranium - Natural uranium contains about 99.28% ^{238}U, 0.71% and 0.0058% ^{234}U. Depleted uranium has the ^{235}U content reduced to about 0.2%. Therefore the properties of the specific material will depend on the percentage of the various isotopes in the material. When the mixture is unknown the specific activity may be estimated as 3.6×10^{-7} Ci/g (10CFR20, Appendix B).

	^{238}U	^{235}U	^{234}U
Specific Activity	3.3×10^{-7} Ci/gm	2.1×10^{-6} Ci/gm	6.16×10^{-3} Ci/gm
Radiological Half-life	4.5×10^{9} yr	7.1×10^{8} yr	2.48×10^{5} yr
Biological Half-life	100 days	100 days	268 days
Major radiation	α4.15, 4.20	α4.37,4.40,4.58	α4.72, 4.77
		γ0.143,.185,.204	γ 0.053
Organ of Interest	Kidney	Kidney	Bone
MPC Water	S 4×10^{-5} µCi/ml	3×10^{-5} µCi/ml	3×10^{-5} µCi/ml
	I 4×10^{-5} µCi/ml	3×10^{-5} µCi/ml	3×10^{-5} µCi/ml
MPC Air	S 3×10^{-12} µCi/ml	2×10^{-11} µCi/ml	2×10^{-11} µCi/ml
	I 5×10^{-12} µCi/ml	4×10^{-12} µCi/ml	4×10^{-12} µCi/ml
MPC Organ of Interest	5×10^{-3} µCi	0.03µCi	0.05µCi

Chemical toxicity is the deciding factor for ^{238}U and ^{235}U. Radiological toxicity is the deciding factor for ^{234}U and enriched uranium in ^{235}U. Depleted uranium, with its high percentage of ^{238}U will also depend on chemical toxicity.

Physical State: Solid; metallic
Melting Point: 1133°C
Boiling Point: Ignites - 3818°C
Density: 19.05

Other Hazards: Pyrophoric when finely divided. (Normally stored under oil when finely divided.)

Name: Krypton - 85

Symbol: ^{85}Kr

Physical State: Gas, inert

Specific Activity: 3.93×10^{2} Ci/gm

Radiological Half-life: 10.73 years

Biological Half-life:

Major Radiation: β 0.672 MeV α γ0.514 MeV

MPC Air: Sub 3×10^{-7} μCi/ml

MPC Water: Sub ----

MPC Organ of Interest:

Organ of Interest: Total Body

Density: 3.708g/ℓ@ $0^{o}C$

Melting Point: $\sim -156^{o}C$

Boiling Point: $\sim -152^{o}C$

Other Hazards: Compressed gas

Name: Promethium - 147

Symbol: ^{147}Pm

Physical State: Solid

Specific Activity: 929 Curies/gram

Radiological Half-life: 2.62 years

Biological Half-life: 1500 days

Major Radiation: B (0.225 MeV)

MPC Air: S 2×10^{-4} µCi/ml
I 2×10^{-4} µCi/ml

MPC Water: S 2×10^{-9} µCi/ml
I 3×10^{-9} µCi/ml

MPC Organ of Interest: 60 µCi

Organ of Interest: Bone

Density:

Melting Point: 1035°C

Boiling Point: 2730°C

Other Hazards:

Name: Radium -226

Symbol: ^{226}Ra

Physical State: Solid

Specific Activity: .988 Curies/gm

Radiological Half-life: 1620 years

Biological Half-life: 1.64×10^{-4} days (?) 10-12 years (?)

Major Radiation: α 4.78 MeV γ0.188 MeV, 0.26 MeV

MPC Air: S 3×10^{-12} μCi/ml
I 2×10^{-12} μCi/ml

MPC Water: S 3×10^{-8} μCi/ml
I 3×10^{-5} μCi/ml

MPC Organ of Interest: 0.1 μCi

Organ of Interest: Bone

Density: ~ 5 gm/cc

Melting Point: 700°C

Boiling Point: ~1737°C

Other Hazards: Decays to radon - 222 a radioactive gas emitting α raditions

Name: Thorium (Natural) Natural thorium is considered to contain 1Ci ^{232}Th and 1Ci ^{228}Th

Symbol: Th (Nat)

Physical State: Solid

Specific Activity: ^{232}Th 1.11×10^{5} pCi/gm; ^{228}Th 8.2×10^{3} Ci/gm

Radiological Half-life: ^{232}Th 1.4×10^{10} years; ^{228}Th 1.91 years

Biological Half-life: ^{232}Th 7.3×10^{4} days ^{228}Th 7.3×10^{4} days

Major Radiation:

^{232}Th	3.953 MeV	^{232}Th		^{228}Th	^{228}Th
α	4.012 MeV	γ0.059 MeV		α5.34	γ0.084
				5.43	0.214

MPC Air:

S 2×10^{-12}
I 2×10^{-12} Th (Nat)

MPC Water:

S 2×10^{-6}
I 2×10^{-5} Th (Nat)

MPC Organ of Interest: 0.04 Ciμ ^{232}Th

Organ of Interest: Bone Th

Density: ~11.66 ^{232}Th

Melting Point: ~1700°C

Boiling Point: ~4000°C

Other Hazards: Parent of radon - 220, a radioactive gas which is an α-emitt

Name: Tritium

Symbol: ^3H or T_2

Physical State: Gas

Specific Activity: 9.64×10^3 Curies/gram

Radiological Half-life: 12.3 years

Biological Half-life: 10-12 days

Major Radiation: β(0.081Mev)

MPC Air: S 2×10^{-7} µCi/ml
I 2×10^{-7} µCi/ml

MPC Water: S 3×10^{-3} µCi/ml
I 3×10^{-3} µCi/ml

MPC Organ of Interest: $2. \times 10^3$ Ci

Organ of Interest: Total Body

Density:

Melting Point:

Boiling Point:

Other Hazards: Flammable gas, similar to hydrogen.